COLONY OF SIERRA LEONE

ANNUAL REPORT

OF THE

Department of Agriculture

FOR THE YEAR

1947

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1949

Annual Report of the Department of Agriculture

STAFF AT 31ST DECEMBER, 1947

DIRECTOR:

R. R. Glanville, C.B.E., B.A., B.Agr. (Dublin), A.R.C.S. (Ireland).

PRINCIPAL AGRICULTURAL OFFICER:

G. W. Lines, M.B.E., M.A., Dip. Agr. (Cantab).

Office Assistant: S. A. D. Peters.

RESEARCH OFFICERS

Plant Pathologist:
F. C. Deighton, O.B.E., M.A. (Cantab.).

Entomologist:
F. A. Squire, B.Sc. (South Africa), A.I.C.T.A.

Agricultural Chemist:
H. W. Dougall, M.Sc. (Durham).

Laboratory Assistants:
J. S. Wellington—Entomology (Senior Assistant)
C. T. Pyne—Mycology
J. O. Belford—Chemistry.

FIELD STAFF:

Senior Agricultural Officers:
H. Macluskie, U.D.A. (Aberdeen)
A. F. MacKenzie, B.Sc. (Hons.) London, A.R.C.S., A.I.C.T.A.

Agricultural Officers:
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R. M. Steven, Dip. I.C.T.A.
P. Adames, M.A. (Oxon), A.I.C.T.A.
E. S. Capstick, B.A. (Agr.) Cantab., A.I.C.T.A.
H. D. Jordan, B.Sc. (Hons.) London, A.R.C.S., A.I.C.T.A.
T. P. Wheldon, B.Sc. (Agr. & Econ.) Bangor
J. M. Dent, B.Sc. (St. Andrews), A.I.C.T.A.
T. S. Jones, B.Sc. (Agr.) Reading, A.I.C.T.A.
J. A. Austin, B.Sc. (Agr.) Reading
E. H. Nichols, B.Sc. (Agr.) Durham
Five vacancies.

Marketing Officer:
S. M. Taylor, B.Sc. (Agr.) (Hons.) Aberystwyth.

Agricultural Superintendents:
G. C. Taylor, B.Agr. (Hampton), B.Sc. (Agr.) (Tuskegee), M.Ed. (Rutgers)
One vacancy.

Livestock Officer: S. A. Roach.

Development Officer: A. S. Kerton (seconded to Agricultural Department).

Agricultural Assistant, Grade III: C. A. Tucker.

Agricultural Instructors, Grade I:

1. A. B. Sidigi
2. D. J. Hadji
3. G. B. Foday
4. S. I. Bull

One vacancy.

Agricultural Instructors, Grade II:

1. I. B. Kamara
2. Y. B. Williams
3. F. J. Short

Three vacancies.

Agricultural Instructors, Grade III: Fifty-three (*seventeen vacancies*).

PRODUCE INSPECTION

Inspector of Produce: K. S. Griffin, Dip. Agr. (Seale Hayne).

Assistant Inspector of Produce: C. G. White.

Produce Examiners, Grade I:

A. R. King
J. J. Kandeh.

Produce Examiners, Grade II:

I. W. Jones
A. Conteh
H. H. John
P. R. Petit
M. I. Cole

Six vacancies.

Produce Examiners, Grade III: Twenty-five (*six vacancies*).

GOVERNMENT RICE MILL

(*Temporarily under the Supplies Department to which the staff is seconded*)

Mill Manager: R. D. J. Macauley.

Assistant Mill Manager: C. E. Taylor.

Storekeeper: J. D. Dupigny.

Mechanic: T. O. Shaw.

SIR,

I have the honour to submit my report for the year 1947.

SECTION I—INTRODUCTION AND POLICY

The filling, during 1947, of the vacancies in the specialised posts of Agricultural Chemist, Marketing Officer and Inspector of Produce, marked an important advance in measures to implement the department's development programme. Unfortunately the staff position in relation to Agricultural Officers remained unsatisfactory and actually deteriorated, with the result that five vacancies remained unfilled at the end of the year with little expectation of any early improvement. This is most discouraging, as any rapid progress with the development programme is dependent on the availability of the full establishment of Agricultural Officers.

2. In spite of the shortage of field staff it was however possible, thanks to the hard work put in by all concerned, to maintain all departmental stations and farms and to effect some expansion of extension work among the farmers. Good progress was made towards increased cultivation of swamps and an extension of planted tree crops on the uplands. The loan scheme to promote mangrove clearance and rice cultivation in tidal swamps was further extended, particularly in Bonthe District. The inland swamp clearance scheme started in the Makeni Circle in 1946 was extended there in 1947, as well as in the Kenema and Port Loko districts, with good results. The distribution to farmers of the best available kinds of seed and planting material of swamp rice and a wide range of economic crops, including oil-palms and fruit trees, was continued. Plans are in hand for a large-scale programme for establishing improved varieties of oil-palms in group plantations, comprising units owned by individual villagers, in suitable parts of the Protectorate. Concurrently the intention is to proceed with the installation of Pioneer oil mills and other mechanical aids for palm oil and palm kernel extraction; and it is hoped that the greater use of machinery will lead to considerably increased production from wild oil-palms as well as, at a later stage, from planted palms. Measures are also being taken, both separately, and in collaboration with the Development of Industries Board, to encourage the use of processing machinery for rice and coffee.

3. Although the rainy season ended early and caused a reduction in rice yields in a few districts, production of rice and subsidiary food crops was, in the aggregate, not less than normal. There was no flood damage and in general there was a small extension of the acreage under cultivation. It was a good year for export produce and farmers benefited very considerably from the increased demand and higher prices for primary agricultural products. Export tonnage of agricultural produce was 69,328 in 1947 as compared with 54,118 in 1946, with an increase in value from £1,107,877 in 1946 to £1,815,899 in 1947. Palm kernels and kola accounted for the bulk of the increase but exports of ginger, coffee and palm oil were also appreciably in excess of those for 1946.

4. During the year the Secretary of State approved an application for a free grant under the Colonial Development and Welfare Act of £47,630 over a period of five years for the purpose of establishing a station for animal husbandry, livestock improvement and pasture research. A suitable site was selected at Musaia, north of Kabala in the Northern Province, and towards the end of the year it was possible to make a start with the construction of roads and buildings. With the arrival of the Agricultural Chemist in June it was at last possible to make progress with the project for chemical research (C.D.W.A. Scheme R 17). The Chemist is concentrating on investigations into the toxicity and other soil problems which have been holding up plans for the large-scale development of mangrove lands for rice production, and there is good reason to believe that when he has completed his investigations he will be able to provide a practical solution.

5. There has been no radical change in the general policy of the department. The following is the approved policy and an outline of the more important work initiated or extended during the year:—

A. The Adequate Provision of Food for the People

This is to be accomplished by:—

I. The improvement and spread of swamp rice cultivation to such an extent that not only will the needs of the people be supplied in a bad year but there will be a surplus for export in ordinary years.

(i) *Mangrove Swamp Reclamation.*—The scheme for the clearing of mangrove swamps in the Moyamba–Bonthe creeks was started by Mr. G. M. Roddan in 1938. Loans, averaging £5 per head, are given to farmers from the Protectorate Mining Benefits Fund. With these loans farmers employ trained mangrove fellers and plant rice. Originally all these fellers were Temnes from the Scarcies where mangrove felling is an art inherited from the past. Gradually the farmers of the southern

creeks have become more expert and many of them are now capable of doing their own felling. Further assistance is given by supplying seed of proved rice varieties from the Scarcies and by instruction in transplanting methods. The work is essentially of a pioneer nature and much credit is due in the first instance to the Temnes from the Scarcies, who settled in the Rotifunk area many years ago and proceeded to develop the Bumpe Creek. This creek is now an object lesson in what can be done over a comparatively short period by the initiative and hard work of practised farmers under the guidance of a progressive, enlightened farmer-Chief.

With assistance from the department the work has now spread to several more creeks in Moyamba District and to the very promising mangrove areas in the neighbourhood of Bonthe. During 1947 a survey was made of the whole of the Moyamba–Bonthe area to get some idea of progress to-date. Although natural difficulties made this survey only approximately accurate it is a fair summary of the position, which is as follows:—

MOYAMBA DISTRICT

(*a*) ASSISTED FARMERS

Chiefdoms	*No. of Farmers Assisted*	*No. of Farmers Farming*	*Area previously Felled*	*Area Felled 1947*	*Total Felled*	*Area planted 1947*
			Acres	*Acres*	*Acres*	*Acres*
Bagru ..	96	40	157	14	171	48
Kagboro ..	195	34	169	—	169	64
Mano-Bagru	13	10	27	—	27	12
Banta ..	41	22	47	—	47	—
Timdale ..	34	8	57	—	57	24
Ribbi ..	19	19	109	14	123	39
Bumpe ..	42	42	455	16	471	326
	440	175	1,021	44	1,065	513

(*b*) UNASSISTED FARMERS

Bumpe ..		357	1,880	42	1,922	1,717
Ribbi ..		58	274	27	301	235
Timdale ..		10	14	—	14	10
		425	2,168	69	2,237	1,962

BONTHE DISTRICT

ASSISTED FARMERS

Imperi ..	200	168	657	7	664	335
Bendu ..	232	169	889	365	1,254	394
Cha ..	54	48	91	—	91	57
Sitia.. ..	28	10	138	—	138	27
S.J.D. ..	18	—	18	—	18	—
Jong ..	5	—	—	—	—	—
	537	395	1,793	372	2,165	813

Summarized, these figures show that, in the two districts combined, 977 farmers have received loans. Of these, 570 actually planted rice in 1947. In addition, 425 independent farmers have cleared and planted without loans. Total acreage of mangroves felled by the two groups is 5,467 acres of which 3,288 acres were actually under rice in 1947. The disappointing chiefdoms are Bagru and Kagboro when compared with the rapid progress in Bumpe. Several factors may be the cause of this difference, namely: ample uplands being available in Bagru and Kagboro, bad soil conditions in Bagru mangrove areas, absence of Temne farmers in Bagru and Kagboro and the fact that Bumpe Creek has an immediate railhead for produce

evacuation whilst the other two creeks are some distance from the rail. In Kagboro Creek there is nothing inherently wrong with the soil and a concentrated effort is to be made there to increase development to the same standard as in the adjacent Bumpe Creek.

(ii) *Saline Swamp Reclamation.*—In the Colony two cleared mangrove areas, Wellington, adjacent to the sea, and Maswari, some distance from the sea, are under experiment to study the reclamation of saline mangrove swamps by empoldering. Wellington was first cultivated in 1945, following an anti-malarial mangrove clearance, whilst Maswari has now been cultivated for rice since 1941. Experience at these two places will decide to what extent the large areas of saline mangrove swamps of the Colony area can be developed for rice production. At Maswari, yields over the past two years have averaged 1,290 lbs. paddy per acre and it is clear, there, that with adequate drainage and given some years for soil conditions to get progressively better, good crops of rice can be grown. At Wellington, where the salt problem is more acute, where drainage is not yet adequate and where soil conditions have not yet become stable, considerably more work is necessary. The Agricultural Chemist has made detailed investigations of the area and with improvements suggested by this work a solution to the problem appears possible.

(iii) *Inland Swamp Cultivation.*—The cultivation of inland swamps, both for rice during the rains and for cassava, sweet potatoes and vegetables during the dry season, is now progressing steadily in most areas under its own impetus. Departmental propaganda, seed distribution and instruction in the technique of swamp cultivation over almost a quarter of a century are showing clear results. The development of organized swamp settlement is being increasingly made the responsibility of the Native Administrations, who bear the cost of initial clearance and rent the land in one-acre lots to individual farmers. This scheme was started in 1946 in the Makeni area, on a small scale. It has now expanded there and has spread to Port Loko and Kenema districts. The scheme is proving popular, is resulting in well-cultivated farms and is likely to expand rapidly in the near future. It also proves, however, that in the early years of any such agricultural scheme it pays to start on a limited scale, giving close attention to detail. Figures of acreages cleared and planted under this scheme are:—

Circle	1946	1947
Makeni	55	127
Rokupr	—	23
Kenema	—	54
Total ..	55	204

(iv) *Swamp Rice Seed Distribution.*—In the years 1935–1946, over 93,000 bushels of seed rice were distributed for swamp planting, under a revolving seed scheme. With this scheme having served its purpose of getting large supplies of improved varieties into general use, and with other work occupying the attention of agricultural staff, it was finally discontinued in 1947. Distribution is now limited to that entirely under Native Administration control except for comparatively small quantities of seed of high grade selected varieties issued by the department on a direct sale or exchange basis.

II. The better Cultivation of Inland Swamps for Crops other than Rice during the Dry Season.

Distribution of dry season swamp planting material of proved varieties of sweet potatoes and cassava was continued from all departmental stations, sub-stations, and Native Administration farms. Dry season swamp cultivation is now common throughout the country. In the Makeni swamp settlement schemes most of the lot-holders are growing dry season crops as well as rice. New strains of vegetable seed from India and onion seed from England, South Africa and Nigeria are being

tested for dry season growing. Whilst all onion seed has grown well, as yet only the Nigerian bulbs have flowered. This, however, is a distinct achievement as they are the first bulbs to produce seeds since trials were started two years ago. Onion seed multiplication should become a possibility in the near future and, with it, there are good prospects of establishing an onion-growing industry.

III. The Extension of Garden and Small Field Crops to serve as an Auxiliary Food Supply.

Market gardening in the Colony area, around the larger towns and in the Kabala area continued steadily during 1947. Kabala is promising as a "European" vegetable-growing district and already a good tonnage of cabbages, lettuce and tomatoes has been sent from there to Freetown. Throughout the country the cultivation of cassava, sweet potatoes, yams and pigeon pea continues to extend. Citrus, pineapple and banana cultivation is also expanding particularly in the Colony and Scarcies area.

IV. The Selection (or introduction) and Distribution of Seeds and Plants suitable for I, II and III.

The selection of imported and local rice varieties has continued at Rokupr and the most promising are being tested and multiplied at all stations; the multiplication and distribution of mosaic-resistant cassava planting material, improved sweet potatoes and yams continued. Numerous other economic crops are being tried out: Indian (Pusa 69) and Hawaiian pigeon peas, Ishan cotton from Nigeria and groundnuts from South Africa are examples. The stage has been reached, however, when it is increasingly rare for a new introduction to show any great improvement upon the already established varieties. Planting material of coconuts, citrus, plantains and bananas, together with the more recently available Angola and Deli oil-palm seeds, are in large demand.

V. The Improvement of Livestock.

Cattle.—Active steps were taken during the year towards the establishment of the new livestock and animal husbandry research station at Musaia, north of Kabala. By the end of the year work was progressing well; roads had been made, fencing erected, the first house constructed, some preliminary clearing done and surveys made for water supply. Early in 1948 it is expected that the transfer of stock from Teko will be possible. The establishment of this station is part of the Ten-year Development Plan and is financed from funds provided under the Colonial Development and Welfare Act.

With the establishment of Musaia, the livestock station at Teko will be closed down as far as this department is concerned, but will remain the headquarters of the Veterinary Department. During 1947, work at Teko, owing to the great loss sustained early in the year in the accidental death of Mr. D. A. McBurney, was largely care-and-maintenance prior to removing to Musaia. Nevertheless, Mr. A. S. Kerton, Development Officer, ably carried on the work and, in addition, initiated a small scale cheese industry.

At Teko, feeding trials and selection by milk yields continued. Since 1944 the average yield of milk per cow per lactation has risen from 390 lbs. to 1,108 lbs. and with this increase there has been a general corresponding all-round improvement in the herd. The small scale production of butter and cream, started in 1945, continued and cheese production was started. The dairy has served a useful purpose in the training of African staff to do this work. It will be expanded at Musaia and it is hoped that eventually cream collection for butter-making from surrounding Foulah herds, comparable to the Nigerian scheme, will be made possible.

The Ndama herd at Njala was largely used in the grassland experiments and for working purposes but at the same time milk yields were recorded and selections made, as at Teko, whilst a preliminary calf-feeding trial was carried out.

Pigs.—Newton, near Freetown, with its modern piggery established in 1945, continued as the main centre for breeding, feeding and management investigations with pure bred Large Whites and Large White-Berkshire crosses. In addition, pig keeping has expanded at Njala and Kenema, again using pure bred stock. At the end of the year the total stock at these three stations was 182, whilst an additional 70 animals had been distributed to local farmers for breeding purposes and 56 had been sold for slaughter. The majority of the animals for slaughter were turned into pork and bacon by the Freetown Cold Storage Company.

Feeding and breeding investigations were continued at all three stations throughout the year. Although satisfactory economic rations, using local products, have been evolved the difficulty in obtaining adequate food, particularly towards the end of the dry season, remains a limiting factor. Local pig keepers in the Colony area have used considerable ingenuity in making use of available by-products such as fish waste, but the obvious basic by-product of Sierra Leone, namely rice meal, is still not in any large supply, apart from that produced by the Government rice mill. Efforts have been made in the Scarcies and elsewhere to see if a supply of meal could be developed from the daily individual hand processing of rice but, so far, without success.

Another problem, which became accentuated during the year, was that some of the Nigerian Large White sows, just after farrowing, developed hindquarter weakness in the form of paralysis. Whether this is due to a diet deficiency or to inherent defects of the strain through over-breeding for large litters is not yet clear. It is noticeable, however, that the Berkshire strain, which produces smaller litters, does not show this defect.

Small Livestock.—Rabbits and Guinea pigs, started during the past three years at various stations, have not proved very successful, despite careful attention. Fecundity has not been great, whilst deaths, usually from unknown causes, have been frequent. Work, however, with both these animals will be continued since they are in popular demand locally, some local farmers having had success, particularly with rabbits.

Poultry.—Newton and Njala continued as the main poultry breeding and distribution centres. Stock is entirely R.I.R. At both places stock is now being multiplied up from the new strain imported from U.S.A. in 1946. Production and distribution during the year were as follows:—

	Eggs Laid	*Eggs Incubated*	*Eggs sold for Hatching*	*Birds sold for Breeding*
Njala	2,612	1,171	720	77
Newton	2,625	761	555	38
Total ..	5,237	1,932	1,275	115

Mortality amongst chicks continued high as a result of fowl pox and predators, although disease was largely confined to the old strain. At Makeni, disease was so bad that poultry work had to be discontinued there.

B. The Cultivation of Money Crops and the Exploitation of Wild Trees for Export Purposes.

1947 was a good year for export produce, the most noticeable increase being palm kernels. The enhanced price paid for kernels was the chief factor in this

increase. The following comparative table of export figures shows how the two post-war years 1946 and 1947 compare with the war and pre-war periods:—

Products	1938	*Average* 1939–45	1946	1947
PALM KERNELS:				
Quantity	63,697	46,483	46,773	61,240
Value	£457,031	£381,081	£688,840	£1,301,742
Price	£7	£12–4	£15	£21
PALM OIL:				
Quantity	1,066	426	107	637
Value	£16,025	£5,270	£4,449	£30,857
Price	£15	£54–11	£41	£48
PIASSAVA:				
Quantity	3,791	2,338	4,118	2,958
Value	£40,369	£55,655	£236,352	£150,315
Price	£10	£40–10	£57	£51
GINGER:				
Quantity	2,705	1,640	982	1,451
Value	£60,680	£53,533	£51,819	£71,258
Price	£22	£54–17	£53	£49
COFFEE:				
Quantity	38	65	132	276
Value	£793	£3,319	£7,305	£15,137
Price	£21	£129–17	£55	£55
COCOA:				
Quantity	384	477	572	439
Value	£5,849	£8,741	£11,653	£16,930
Price	£15	£22–12	£20	£38
KOLA:				
Quantity	1,450	997	1,307	2,300
Value	£29,785	£34,922	£105,470	£229,099
Price	£20	£27–41	£81	£99
BENNISEED:				
Quantity	374	197	127	3
Value	£3,700	£1,993	£1,999	£55
Price	£10	£11–9	£16	£18
GROUNDNUTS:				
Quantity	Nil	—	—	24
Value	—	—	—	£506
Price	—	—	—	£21
Total tonnage, all exports	73,505	52,603	54,118	69,328
Total value all exports	£614,232	£544,514	£1,107,887	£1,815,899

Note.—Quantities are quoted in tons. Prices 1939–45 are the maximum and minimum prices per ton during that period. Other years show average ruling prices per ton. These figures are all quoted from export statistics, the actual monetary value to producers would probably average two-thirds of the figures shown.

It should be emphasized that whilst the 1946-47 figures show the recovery from the war years they do not give an entirely accurate picture of actual production, since, with shipping not yet fully back to normal, a considerable amount of produce may be kept in storage and not exported in the year of purchase. Also, in some cases, as with piassava in 1946, there was a considerable quantity included, of material which had accumulated from previous years.

Very encouraging are the steady improvements in palm kernels, palm oil, cocoa, coffee and kola. The apparent decline in cocoa and benniseed is not borne out by the 1947-48 buying season, when, with enhanced prices, production figures show these crops to have had a seasonal production of over 800 tons (a record) and 200 tons respectively.

The export of rice, as in previous years, was on a very limited scale, some sixteen tons only being allowed export. During the year the war-time rice quota system was abolished, with a return to free trading. It was, therefore, not possible to consider export until the local supply position could be gauged under the new conditions.

With the United Kingdom shortage of vegetable oils continuing, and with the sharp increase in the price of linseed oil, the possibilities of exploiting various oil-bearing wild plants, not normally considered to be worthwhile exporting, were investigated during the year. As a result the first commercial buying was made, late in the year, of the seeds of the oil-bean tree (*Pentaclethra macrophylla*). Samples of other potentially suitable oil-bearing seeds were collected and submitted to commercial concerns and to United Kingdom authorities. It is too early yet to state whether or not an export production will develop in any of these. So far, *Pycnanthus kombo*, *Carapa procera* and *Tetracarpidium conophorum* offer possibilities, although not on a large scale.

During the year a trial preparation of copra was made at Gbap in the Bonthe river area. It received an excellent commercial report and arrangements were made to start buying late in the year. With the local prices of fresh coconuts still high it is doubtful if an export trade in copra can be built up, but buying will continue and results may show within the next few years.

C. Soil Conservation

It has not yet been found possible to implement the proposal made at the end of 1946 for the formation of a soil conservation team comprising Administrative, Agricultural and Forestry officers. Meanwhile propaganda and assistance have continued to be given, in all areas, towards swamp cultivation as opposed to upland farming. The Forestry Department initiated a scheme in 1945, in Kenema District whereby the Tribal Authorities declared certain upland areas, in danger of over-farming, to be "soil conservation areas." Within these areas farming is not allowed or is strictly controlled. Starting with one chiefdom, Nongowa, four more chiefdoms have adopted the same procedure. In Makeni District destructive hillside farming is widespread. An extension of the Kenema soil conservation scheme is hoped to be made in Makeni District in 1948, and, to this end, the Agricultural Officer, Forestry Officer and the Administration are co-operating together. Early burning of grasslands instead of the more harmful late burning is also being advocated.

D. The Improvement in the Preparation and Marketing of Ppoduce

With the arrival of Major S. M. Taylor at the beginning of the year the new appointment of Marketing Officer was filled. He proceeded to organize a Marketing Branch of the department, to collect statistics, to investigate the possibilities of establishing processing industries, to study methods to improve quality of agricultural products and to make a preliminary study of the internal and external marketing of produce. He also made an extended tour of Nigeria in order to become familiar with comparable work there and primarily to get first-hand knowledge of large-scale palm oil mills.

The Marketing Officer made detailed treks in the main oil-palm, cocoa, coffee and rice-producing areas of Sierra Leone, following which he carried out tests on nutcracking and coffee processing machines, drafted cocoa inspection and grading rules and assisted in the first establishment of hand nutcrackers in a few chiefdoms. More hand nutcrackers, as well as several power nutcrackers and two Pioneer oil mills have been ordered.

It is clear that oil-palm products still afford the largest and most promising line of approach to increased exports and, with the mechanization of kernel and oil production, together with the newly-initiated programme for planting improved oil-palms the Marketing Officer is actively concerned. Subsidiary to this main, relatively long-term work, machine processing of coffee and fruit juices appear to be promising as outlets for African enterprise, as do small rice mills and soap manufacture. As the result of detailed tests it is now possible to recommend suitable coffee hullers and pulpers and to establish the first fruit juice plant in Freetown. An African concern has started the production of bar soap of good quality, using local palm oil.

With regard to rice milling the large Cline Town rice mill, which was established by the department before the war, continued successfully under the Supplies Department, whilst a similar mill has been ordered for establishment by the department at Mambolo in the Scarcies rice area. The smaller mills at Rokupr and Kenema, after a particularly good year at Rokupr when over 10,000 bushels were milled, are being disposed of to Africans through the Development of Industries Board.

General agricultural propaganda and instructional work continued, in the districts, as in previous years in the proper preparation of cocoa, ginger, piassava and coffee. Ginger and piassava are still sold on a free market, liable to price fluctuations, piassava being affected very considerably by a sudden price fall from £75 to £43 per ton early in the year. Such conditions in no way assist the work of instructors in their efforts to improve produce preparation amongst farmers. In contrast, cocoa and coffee with the prospects of continued stabilized good prices should ensure a good response from producers in improved preparation.

E. The Preservation of the Standard of Export Produce by Inspection

Mr. K. S. Griffin was appointed as Inspector of Produce at the beginning of the year and with the increased recruitment of African staff it was possible to open four new inspection stations during the year and to augment staff at other stations. Credit is due to Mr. C. G. White, Assistant Inspector of Produce, who carried on the work of the branch during the difficult years 1943–46.

The Inspector of Produce made extensive tours of the oil-palm, cocoa, ginger and piassava areas, in several instances accompanied by the Marketing Officer, thus obtaining first-hand knowledge of production at the source and building up a close *liaison* between his branch and the Marketing Branch. With many of the examiners being new beginners, with up-country produce buying still largely in the hands of numerous middlemen all competing for quantity, with up-country trading practices still leaving much to be desired and with many stores in poor condition, the work of produce inspection has not been easy. It is encouraging to report, therefore, that with the exception of some complaints at the end of the year, over piassava, there were no complaints from overseas during the year for any other export produce.

Palm kernels, ginger and piassava continued as the main products inspected but careful study of cocoa preparation in the Kenema cocoa area was made and preliminary rules were formulated which are expected to be drafted into the Native Produce (Inspection) Rules in 1948. Thus, by the 1948/49 cocoa season it is hoped that full-scale cocoa inspection will be added to the duties of the branch.

Investigations into storage conditions, especially those up-country, were made. As soon as supplies of building material become more readily available the much needed reconditioning and rebuilding of produce stores can be undertaken. Until that time, however, storage regulations can only be enforced as far as they are practicable. Despite this, with the advice of the Inspector of Produce and regular inspection of stores, there have been signs of improvement, showing that traders are gradually becoming more keenly aware of the importance of good storage.

F. Co-operation with the Education Department where possible in the Teaching of Agriculture

The training of future agricultural instructors continued at Njala Training College, now in its ninth year. This college, run conjointly by the Education and Agricultural departments, trains both elementary school teachers and agricultural instructors. The standard of education of the agricultural group at entry has become progressively higher, so much so that during the year a complete revision of the agricultural course was carried out to make it possible in the near future for the course to be reduced from four to three years. Twenty-one agricultural students were in residence during the year and eleven new students will start the course early in 1948. So far, the Njala Training College has supplied 32 agricultural instructors to the department. Additional to the work at the Njala Training College, agricultural staff has given instruction and assistance to school gardening in the Protectorate.

G. Research

Plant pathology, entomology and agricultural chemistry constitute the three sections of the research side of the department, with laboratories at Njala. The resuscitation of the chemistry section, started in 1945, was completed with the arrival in June, 1947, of Mr. H. W. Dougall as Agricultural Chemist. All three sections are now well staffed and good progress in applied research was made during the year; notably, detailed investigations into the soil problems of reclaimed swamp areas, the identification and treatment of various crop pests and an investigation into the habits of different species of Tsetse fly. Full details of work carried out are given under the appropriate sections of this report.

H. Nutrition

On the whole, 1947 was a satisfactory year for all food crops. The increased production of palm kernels and the rise in export of palm oil indicated that palm oil supplies within the country were in a satisfactory state. The production of pork and bacon, though comparatively small, offers good future prospects as addition to the never adequate meat diet. In the Northern Province there was a most encouraging and considerable increase in two valuable articles of diet—tomatoes and pigeon pea.

I. Extension Work. All Extension Work and Propaganda must be based on Information gained from Experiment or from Experience by Agricultural Officers in Sierra Leone

As for many years past, the main object of extension work is still the maintenance of fertility and the conservation of the soil by the maximum development of swamps for annual crops as opposed to over-farming of the uplands. Concurrently the substitution of permanent tree crops such as improved oil-palms, cocoa and fruit trees for upland annual crops is encouraged, whilst trials are being made with grasslands, fertilizers and composts in an effort to evolve a satisfactory system of continuous upland cropping, preferably on a mixed-farming basis.

Swamp development is being tackled from several different angles, namely: the Inland Swamp Clearance Scheme under Native Administrations as at Makeni, the departmental mangrove clearing scheme in the creeks and tidal rivers of the Moyamba–Bonthe areas, the empoldering and drainage experiments of cleared saline mangrove swamps at Maswari and Wellington and the drainage and mechanical cultivation experiments in the Scarcies. All these projects are excellent examples of the necessity for starting any scheme on a limited trial scale, collecting basic data, overcoming unforeseen difficulties and accumulating experience before embarking on full-scale expansion programmes. The Makeni Inland Swamp Clearance Scheme was worked out in close detail, over a small acreage (55 acres), in 1946, with close

supervision of all the farmers. The scheme was a marked success and in 1947 has expanded to Kenema and Rokupr areas, again on a closely supervised small scale. Total acreage producing excellent crops of rice under this system is now 204. In succeeding years, with the experience already gained, it is safe to say that there will be a cumulative effect spreading to several more districts. At Maswari saline swamp clearance test area, the experimental period has taken longer but, during 1947, the first few farmers were allowed into the area, grew successful crops, and there is every indication that more will follow in increasing numbers in the near future. In a similar project at Wellington, in a small test area adjacent to the sea, experimental results show that a system of empoldering, drainage and cuturall operations which can be safely advocated to farmers has yet to be evolved. There are hopeful signs, however, that a solution will be found shortly. In the Scarcies swamp drainage schemes the tale is different, but it still emphasizes the paramount necessity for experiment before adopting large-scale operations. During the war, with urgent large rice expansion needed, empoldering on a considerable scale was initiated in certain areas of the Scarcies, with insufficient data and without preliminary small-scale trials. Results were such that in 1946 and 1947 the whole scheme has had to be drastically curtailed and has, in fact, had to revert to comparatively small-scale trials. In the Scarcies reclaimed areas mechanical cultivation is also being carried out. Here, however, progress has been held up by the difficulty of getting a suitable tractor. The only available tractor in 1947 was a Fordson wheeled tractor. So far soil conditions have made it a failure in the swamp cultivation tests although successful on upland. A track tractor has now arrived, and its performance is awaited with interest.

Swampland development is closely concerned with the introduction of suitable improved rice varieties, and, for dry season cultivation, the provision of planting material of improved cassava and sweet potato varieties. Rice breeding and selection work at Rokupr and selection trials of dry season swamp crops at other stations over many years, now make it possible for seeds and planting material of several proved varieties to be distributed. Their widespread popularity throughout the country is a further confirmation that experiment and trial are essential if extension amongst farmers is to be successful.

As a result of the collection of data and selection work on the Angola, Deli and Nigerian oil-palm plots at Njala it has now become possible, within the past two years, to distribute with confidence a large number of seeds of these varieties and to establish nurseries throughout the country, either under Native Administrations or under the department. A planting programme using these varieties has been drawn up and within the next few years results should begin to show. Meanwhile, after trials, several hand nutcrackers are at work in various chiefdoms, the demand for them is increasing and power nutcrackers are on order for trial.

Other types of machinery on trial during the year were coffee hullers and pulpers, fruit juice extractors and small rice mills. The demand amongst Africans for these small rice mills is increasing and it is expected that during 1948 all the departmental rice mills will be disposed of to local concerns. The fruit juice machine worked satisfactorily and, combined with the small canning plant, is shortly expected to be operated by an African commercial concern.

Experience gained at Newton, Njala and Kenema in pig-keeping and breeding has now enabled the department to increase its distribution of pure bred stock, particularly in the environs of Freetown, and to advocate suitable buildings, diet and management. Extension in this direction will naturally proceed more slowly than with crops and each extension will need close attention. It is, however, one of the most promising lines of development to increase the meat supply of the people in a relatively short period, but, again, without continued research under West African conditions such development will not be a lasting success.

SECTION II—THE WORK OF THE AGRICULTURAL DEPARTMENT

(*a*) Organisation and Staff

6. Although the department is not yet up to full strength, the staff position was considerably improved by the filling of the three specialist posts, long vacant, of Marketing Officer, Inspector of Produce and Agricultural Chemist. On the other hand the department suffered a particularly heavy and sad loss on the 27th of May when Mr. D. A. McBurney, Agricultural Officer specialising in livestock work, died as the result of a motor accident at Allen Town hill. Another Agricultural Officer, Mr. M. A. G. Hanschell, was transferred to St. Vincent, and as there was only one new appointment during the year there are now five vacancies in the Agricultural Officer establishment; until these shortages are made good there is little hope of making satisfactory progress with the development programme.

7 The junior technical grades were augmented by the appointment of twelve additional Produce Examiners and it is now possible to provide for more rigid inspection of export produce. The recruitment and training of Native Administration staff to take charge of seed farms and to assist with extension work progressed satisfactorily.

(*b*) Agricultural Stations

Njala

8. *Crops.*—Experimental work continued on the lines of previous years towards the establishment and management of upland pastures with the possibility of (*a*) recuperating the fertility by rotational grazing of cattle; (*b*) improvement of grasslands for stock feeding; (*c*) substituting grassland for bush fallow. Investigations were made in establishing various types of grass on land liable to flooding during the rainy season.

9. *Upland Grasses.*—During the past three years the upland grass trials have resolved themselves into trials between the two grasses, Elephant grass (*Pennisetum purpureum*) and Guinea grass (*Panicum maximum*). A third grass, *Andropogon tectorum*, failed early in the trials. Grazing figures in cow-days per acre, based on various experiments and calculated from all plots which received no manure other than that received naturally during grazing, are as follows:—

	Elephant Grass	*Guinea Grass*
1944 ..	151	291
1945 ..	273	447
1946 ..	80	243
1947 ..	—	349

In 1947 the Elephant grass had not recovered from the previous year's grazing and it could not be grazed. It was however, cut for fodder, giving a yield of 12,062 lbs. per acre.

10. In order to compare methods of grazing a trial was started in 1946, with Elephant grass and Guinea grass, comparing grazing by a group of cattle and grazing by a single animal. Figures in cow-days per acre are:—

	Elephant Grass		*Guinea Grass*	
	1946	1947	1946	1947
Single animal grazing ..	64	—	167	316
Mass grazing	96	—	320	382

In 1947 growth of the Elephant grass was such that it could not be grazed. It is clear that with Guinea grass mass grazing is better than single animal grazing, the regeneration being better and more uniform.

11. From experiments comparing different intervals of grazing, i.e. from three weeks up to nine weeks it is evident that grazing at set intervals, short or long, is unsatisfactory. It has proved preferable to graze according to the weather and natural growth of the grass, allowing the grass to regenerate to optimum succulent growth before any fresh grazing. Even so, a certain amount of cutting is at times necessary in order to check coarse cany growth. Under this system of management using closely planted Guinea grass, it is possible to get a good permanent upland pasture giving a maximum feed of green grass during the rains and a fair amount of fresh grazing even during the long dry season.

12. As regards cut fodder, Guinea grass has proved to be the best grass so far used for uplands. An acre block, cut four times each year has given the following yields:—

1945	7,744 lbs.
1946	17,358 „
1947	20,620 „

13. *Swamp Grasses.*—In swamps, however, Elephant grass is distinctly better than Guinea grass for cut fodder, as the following figures show:—

YIELDS IN LB. PER ACRE

	Unmanured Plots		*Manured Plots*	
Year	*Elephant Grass*	*Guinea Grass*	*Elephant Grass*	*Guinea Grass*
1946	4,170	1,940	6,066	2,200
1947	12,072	2,696	29,952	13,064
Total ...	16,242	4,636	36,018	15,264

14. Of the other grasses which have been tried in swamps *Paspalum dilatatum*, *Axonopus compressus*, Para grass and the local *Panicum laxum* have proved worth continuing with. Para grass will have to be watched, as with its strong growth it competes with other grasses and is liable to become a weed. Rhodes grass and *Cenchrus ciliaris* have both failed. The natural *Panicum laxum* is proving very satisfactory, one-acre trial plot giving 96 cow-days and 12,179 lbs. of cut fodder during 1947 and another one-acre plot, receiving grazing only, giving 334 cow-days grazing during the year. Guinea grass, under swamp conditions, does not tiller as well as it does on the uplands. New strains of this grass imported from Puerto Rico and Queensland are being observed both for swamp and upland growth. On the uplands two perennial strains of *Pennisetum polystachyon* and Para grass have also been established for observation.

15. *Leguminous Fodder Crops.*—*Pueraria phaseoloides* has, over a number of years, established its reputation in Sierra Leone as being the best leguminous fodder crop. It withstands the dry season, is a good cover crop and makes excellent cut fodder or silage, which is very palatable to all forms of livestock.

16. *Annual Crops*—(*a*) *Yams.*—The yam varieties on trial in 1946 were continued during 1947. Yields were as follows:—

Variety	*Tons per acre* 1946	1947
No. 32 Nigerian ..	8.32	4.29
No. 33 „ ..	7.76	1.43
No. 105 „ ..	3.00	2.00
No. 152 „ ..	4.41	.87
Jaffna King	6.30	3.20
Yellow	2.63	2.88
Port Loko	1.01	.68

In 1946 the yams were grown on land which had been continuously cropped for nine years, the yams receiving compost at the rate of 35 tons per acre. In 1947, the yams were grown, without compost, on newly-cleared land which had previously been in high bush for at least fourteen consecutive years. Although the trial was only for observation, with no statistical control, it would appear that the permanent cultivation using compost was better than a long bush fallow.

(*b*) *Cassava.*—An artificial fertilizer trial on cassava was started but yields will not be known until 1948 harvest.

(*c*) *Ginger.*—Variety trials on ginger continued but, again, yields await 1948 harvest.

(*d*) *Maintenance of Varieties.*—Small plots of many local and imported upland rice varieties were grown for observation, together with a wide variety of legumes, sweet potatoes and grasses.

17. *Permanent Crops.*—Yields from individual trees continued to be recorded from the established plantations of citrus, coffee and oil-palms (Deli, Nigerian, Angola). The fertilizer trial with Marsh grapefruit, laid down in 1946, was continued, comparing the effects on yield of fruit of complete artificials; phosphate alone; potash alone. Marketable quantities of cinnamon bark were prepared and sent to the Imperial Institute and various trading concerns for report. Reports were encouraging, but with no guarantee of a future demand no extension of cinnamon planting amongst farmers was encouraged. The fall in price at the end of the year further justified this caution. The high costs and considerable skill necessary in preparing cinnamon quills make this crop of doubtful economic value. Nursery propagation of all types of permanent economic trees and ornamentals continued on a large scale. Despite the large numbers of seedlings produced and distributed the demand exceeds supply. In particular citrus of all types, coconuts and improved oil-palms are very popular.

18. *Oil-Palms.*—With this major crop, work at Njala is largely concerned in propagating and distributing the three improved varieties, Angola, Deli and Nigerian, and in collecting data to enable further selection of these types to be made. The Njala plantations are the chief source of distribution both to other stations and to farmers. Distribution of seedlings from selected parent plants has been done steadily since 1934, but on a comparatively limited scale, averaging 550 seedlings annually in the pre-war years, 1,040 during the war and 737 during the last two years. New nurseries have been made to multiply seedlings for distribution, but the main distribution is now in the form of seeds. During the war years an average of 15,000 seeds were distributed. This has now been stepped up to 57,000 in 1946 and 310,000 in 1947. This distribution is directly concerned with the scheme for Native Administration and individual farmers' plantations of improved oil-palms.

19. *Cattle*—The Ndama herd at Njala maintained reasonably good health throughout the year. Unfortunately the best cow, which had given consistently the highest milk yields over several years, was killed by arsenical poison, the source

of which could not be traced. The only other deaths were one from tympanitis and one from enteritis. Amongst the working animals an average of 585 hours were worked by each animal, with no more than four hours daily being the allowed maximum. A preliminary calf-feeding trial was carried out using the two following rations:—

	Ration A per cent	*Ration B* per cent
Cassava meal	29	—
Maize ,, ...	14.5	40
Palm kernel meal	11.1	40
Groundnut ,, ...	7.25	—
Blood ,, ...	7.25	16
Guinea corn ,, ...	14.5	—
Bone ,, ...	—	1
Rice bran	14.5	—
Salt	1.8	3

All calves were approximately the same age and received identical treatment, including free range and similar milk supply, the only difference being in rations. Results indicate that there was no difference in the feeding value of the two rations but that costs per lb. liveweight increase was half as expensive with Ration *A* as with Ration *B*.

20. *Pigs*.—During the year the proposal, made in 1946, to introduce Large Whites at Njala for comparison with the established Berkshire strain, was implemented. The Large Whites were imported Nigerian strain bred at Newton and, as has happened in a few cases at Newton, they suffered from hindquarter weakness during the suckling period. This strain may have been too highly bred for large litters at the expense of stamina, at least under Sierra Leone conditions, although it is also possible that feeding is not yet fully understood and a mineral or other deficiency during suckling may be a factor. The Berkshire strain, on the other hand, has shown no signs of weakness during suckling but this is probably correlated with the fact that these Berkshires do not produce large litters. Worm infection of young pigs occurred during one month but was quickly cleared by treatment. Apart from this, one sow showed symptoms of trypanosomiasis which responded to treatment with antimosan, whilst another had epistaxis which responded to M. & B. 693. Stock at the end of the year numbered 48 whilst during the year 21 animals were culled and 12 sold to local farmers for breeding purposes. Feeding material, as at Newton, was difficult at various times and local foodstuffs prices increased. Even so it was possible to show a good economic return.

21. In view of the importance of cassava as a pig food a feeding trial was made with piglets, comparing unpeeled cassava with peeled cassava. There is a local belief that unpeeled cassava, containing glucosides, produces digestive ailments of a fatal nature. Results of the trial show that unpeeled cassava—only roots of sweet varieties were used—had no ill-effects and that it can safely be fed to pigs.

22. *Poultry*.—The fresh Rhode Island Red stock imported from the United States of America during 1946 has been multiplied to form basic distribution stock. Fertility is good and the strain is proving superior in laying capacity. During the year 1,171 eggs were incubated and 720 sold for hatching.

23. *Rabbits*.—Rabbits, first started at Njala in 1946, had a bad period in the early part of the year, when a large number died from what is believed to be coccidiosis of the liver. This occurred when the animals were allowed a free run on grass. Since keeping the rabbits off grass runs there have only been sporadic isolated deaths. There is a keen local interest in these animals. During the year, sixteen rabbits were sold for breeding and several local farmers have had fair results.

24. *Extension Work.—Inland Swamp Development.*—Propaganda continued in Bo–Pujehun districts to encourage farmers to cultivate swamps. A survey in 1947 showed that 5,700 farmers in this area had swamp farms. There is, however, no acute shortage of uplands in this area and inland swamp development is in consequence not so rapid as in some other districts. Dry season swamp development, particularly with vegetables, is now an established practice round the larger towns.

25. *Mangrove-clearing Loan Scheme.*—A full survey of the creek chiefdoms in Moyamba District was made during the year and a reasonably accurate assessment of progress is now possible. Details have been given in the table on page 4. The striking feature is the way in which one chiefdom, Bumpe, under a progressive, enlightened Chief, who is himself a first class farmer, has gone rapidly ahead. The other noticeable fact is the way in which farmers, without any loans, have expanded mangrove felling, again particularly in Bumpe Chiefdom. This progress, admittedly, cannot be ascribed entirely to the work of the department but the initiative has been given by the provision of improved varieties, transplanting instructions, propaganda and loans for mangrove felling. That such progress depends largely upon the initiative and support of the local Chiefs is seen by the marked contrast between the Bumpe and Kagboro creeks. These creeks are adjacent to each other with similar conditions of soil and vegetation, yet Bumpe has gone right ahead whereas in the Kagboro, despite the large amount of labour put into the original mangrove felling, planting has regressed. Concentrated attention from the agricultural staff, however, is to be made in the Kagboro Creek since it is thought that, with patience it has every chance of becoming equally as good as Bumpe Creek.

26. *Ginger.*—This is a main product of the Moyamba District. It is, however, a product which is very dependent upon quality. Demand at present is considerably less than in pre-war years. It is hoped that as trade and shipping become normal overseas demand will increase and, in readiness for such demand, instructions in preparation, together with strict inspection up-country and before export, have been continued since 1945. Quality is now satisfactory.

27. *Cocoa.*—With the increased price there has been a keen revival of interest by cocoa farmers in Bo–Pujehun districts, both in attention to plantations and in preparation of cocoa for market. Propaganda was directed to increased planting, clearing-up of plantations and better fermenting and drying of beans. Although, owing to the smallness of the quantities used, fermentation is still not fully up to standard, there has been marked improvement, whilst the relative absence of mouldy, weevily and germinated beans is encouraging. A census of cocoa farms, carried out during the year, gave the following figures for Bo–Pujehun districts: 921 farmers with 1,581 acres in production.

28. *Coffee.*—As with cocoa, the increased price has led to renewed interest in Robusta coffee. It is unfortunate that most of the plantations in this area are of Liberica type, for which there is little demand. Figures indicate, however, that there are some 300 acres of Robusta plantations in the area.

29. *Piassava.*—Intensive instructional and produce inspection work was carried out, as in 1946, to improve the quality of piassava in this area. The whole of the Sulima District is included here, providing the greater part of total Sierra Leone exports. A "close" season was instituted for the first time to prevent buying and consequent damp storage during the rains. Experience, however, showed that this was of doubtful benefit and, together with the sharp decline in prices from the previous boom year, it had an adverse effect on quality and quantity of shipments at the latter end of the year. It is expected that with continued propaganda and with the discontinuance of the "close" season the situation will soon improve.

30. *Native Administration Farms.*—These are a comparatively recent innovation in this circle. The first, established at Bumpe (Bo) in 1946 is now well forward; a second, at Potoru, was started in 1947, whilst a trainee has been sent to Njala in readiness to start a third farm, at Tikonko, in 1948.

Rokupr

31. *Experimental Station—Soil Toxicity.*—In general, toxic soil conditions within the empoldered area of the farm have shown no improvement during the year. The affected portions have spread, despite applying dry season flood-fallowing to a number of blocks. Indications in 1946 were that such fallowing might improve soil conditions but experience in 1947 seems to show that without free drainage the iron salts remain in the soil and may even become more accentuated. The Agricultural Chemist began full investigations during the latter half of the year. As a result of these investigations drainage of the whole farm is to be improved and, with the exception of a limited area reserved for further chemical research, the farm is to revert to natural tidal conditions. Details of the Agricultural Chemist's investigations are given in the chemistry section of this report.

32. *Rice Selection.*—Outside the bunded portion of the farm rice has grown well. There, and on the less toxic portions within the empolder, work on rice selection and maintenance of varieties has continued. These varieties, totalling 100, include some 50 named and unnamed local varieties together with varieties from Burma, Peru, Madras, British Guiana, French Guinea, Ceylon and Nigeria. Panicle selections of a few of the most promising local varieties and six established imported varieties have been made. Selection is made on flowering curves and laboratory examinations. The established varieties Toma, India-palil, Ngasein, Indo-China, Kavungipoothala and D.C. 39 have now received progressive selection since 1945.

33. *Other Crops.*—Improved varieties of yams, sweet potato, mosaic-resisting cassava and Angola oil-palms were multiplied for distribution to local farmers and Native Administrations. Various legumes including sunn hemp, green gram and cowpeas were also given a trial. Of these, green gram and sunn hemp did reasonably well although preparation of fibre from sunn hemp proved too costly to be economic. Onions from different sources were grown in an endeavour to produce seed, but with no success.

34. *Mechanical Threshing.*—A Ransome's Pygmy thresher was given a trial. It worked well and should prove of considerable value in introducing the idea of mechanical threshing amongst Scarcies rice farmers.

35. *Swamp Clearance Schemes.*—Swamp clearance schemes for rice production were started at two places in 1947 on lines similar to those found successful in Makeni District, i.e. clearance being done with funds provided by the Native Administrations who receive rent from individual farmers who have been allocated, one-acre plots. The first place was an inland raffia swamp at Rogbalan and here 22 acres were fully cleared and cultivated. Lot holders have been well satisfied with first results. The second place was a mangrove creek at Rowal and here nineteen acres were felled and a trial plot of one acre planted with rice, which grew successfully. These are the first extensions on these lines in the Scarcies area, and with care, should be capable of rapid expansion in the future.

36. *Irrigation and Drainage Schemes.*—Work in 1947 was confined to test plots in the empoldered areas at Luti, Rosino and Funkudeh. The Land Drainage Branch of the Public Works Department continued constructional experimental drainage work at the first two places on lines laid down by the visiting Consulting Engineer in 1946. The essential differences between this modified drainage system at Luti and the original large scheme, which failed in 1944 and 1945, are that the main channels and side drains are now open to the ebb and flow of tidal river water with each area divided up into units. Each unit has its own system of box sluices and water can be controlled unit by unit. Although this system of water control is promising, good crops of rice have not yet been obtained. Early planted rice nurseries, however, were quite good. At Funkudeh no constructional alterations to the original scheme were made, but the breaching of the main empolder in 1946

has begun to ameliorate conditions in the area subject to tidal flooding. Similarly at Yakban, although the bunds were only breached in July, successful rice crops were grown by local farmers within the tidal section. The badly drained portions of all the empoldered areas remained unproductive and it is becoming more obvious that improvement of drainage, utilising as far as possible the natural creeks and channels, affords the best line of approach to the satisfactory expansion of rice-growing in these areas. The Agricultural Chemist has instituted intensive investigations in all areas and it is not too much to expect that his efforts and those of the drainage engineers will meet with success in the reasonably near future.

37. *Swamp Mechanical Cultivation.*—With a view to investigating the possibilities of mechanical cultivation in the large areas of swampland in the Scarcies, a wheeled Fordson Major tractor and a track tractor were ordered in 1945. By the end of 1946 the wheeled tractor had arrived but up to the end of 1947 the track tractor had not been delivered. The Fordson Major was given an extended trial at Rosino in 1947, using a three-furrow "Motrac" plough and an eight-foot Ransome disc harrow. Work was started in February, at the height of the dry season, with the ground appearing reasonably firm. Difficulties, however, were soon encountered, chief of which was the bogging down of the tractor. Under the upper crust of dry soil the land was liable to be soft in patches. Here, as at Rokupr farm, the weight of the tractor was too much and the machine was continually sinking. In the disc harrowing operation, after ploughing, the surface had baked into hard large clods which jammed between the discs whilst the wear on the tractor tyre-treads on the surface was considerable. In all, 22 acres were ploughed and harrowed at Rosino during February and March. It was clear, however, that operations in swamplands with a wheeled tractor are neither practicable nor economic. Further developments will have to await the arrival of a track tractor. (This tractor (T.D. 6) arrived in January, 1948, and preliminary trials are most promising.)

38. *Seed Multiplication and Distribution.*—The main Rokupr Station, Port Loko sub-station and the Marampa Native Administration farm continued as centres for raising and distributing planting material of all kinds. Native Administration farms opened in 1945 at Kaffu Bullom and Tonko Limba have been further improved, whilst three new farms were started in 1947 at Samu, Mambolo and Magbema. Nurseries of Deli and Nigerian oil-palms have been established at all farms. Pure seed rice distribution was limited to 500 bushels whilst 1,200 bushels were sent to the Gambia. Of other crops, mosaic-resisting cassava, Mississippi sweet potato and high-yielding yam varieties continued to be in most popular demand for planting.

39. *Rice Mills.*—The small No. 1 planters mill at Rokupr had another successful season, milling some 10,000 bushels of rice in the season January to September. With the cessation of the quota rice system, the mill is no longer required by Government and will be handed over to local African enterprise. Machinery for the proposed new large mill at Mambolo is on order.

40. *Produce Trade.*—With the increase in price of palm kernels, production in the Scarcies area increased visibly but, as with rice, the prices offered over the border in French Guinea have been considerably higher than local prices. In consequence an appreciable quantity of kernels and rice was sold into French territory.

Kenema

41. This station is the centre for experimental and extension work in the South-eastern portion of Sierra Leone. The basis of its work is inland swamp development, but being in the main cocoa and oil-palm area it is also largely concerned with development of these crops. In addition, more as a long-term effort, work is being carried out with cattle and pigs. A detailed soil conservation investigation of a selected chiefdom is also being carried out.

42. *Crops.*—Reorganization of the farm started in 1946, to make it more intensively cultivated, was continued in 1947. A trial was made comparing the effects of compost and green manure upon swamp rice, the controls having no manure. Differences were not significant but the trial is to be continued. A trial was also made comparing rice broadcasting and transplanting. Again no significant differences were shown.

43. *Livestock.*—The small herd of Ndama cattle maintained good health and were used to start a grazing trial with Guinea grass. The improvement in the pigs, consequent upon the re-stocking with Large White strain in 1946, continued during 1947 and, by the end of the year, a small but flourishing herd had been built up. As at other stations feeding has become a problem as numbers increase. It is intended in 1948 to establish a local pig-keeper with stock. His experience in obtaining food should help to show whether or not further pig-keeping extension can be made in the Kenema area.

44. *Extension Work—Native Administration Farms.*—Twenty Native Administrations in Kenema circle employed agricultural demonstrators and eighteen of them had small swamp farms for demonstration and seed production purposes. The desire for so many Native Administrations to have their own separate concerns, however, is a mixed blessing since, from one cause or another, they cannot all be run successfully. A further function of the Native Administrations, agriculturally, is to arrange the distribution of planting material. This is working well, although at the same time a certain amount of distribution is done departmentally.

45. *Swamp Development Schemes.*—The traditional method of rice-growing in Kenema area, as in most of the Protectorate, is broadcasting upon uplands. Prior to 1925, little or no attention appears to have been paid to inland swamp cultivation. In 1925, however, 30 swamp farms were established in twelve chiefdoms of Kailahun District under the direct supervision of the department and instructions in nursery preparation and transplanting were given. In 1928, the department supervised the planting of 84 swamp farms by private farmers in Kailahun. In 1929, it was decided that the work was well established and instructors were transferred elsewhere. Since then, propaganda and distribution of swamp rice varieties have gone on steadily but the conservatism of upland farmers has made progress to the swamps only gradual. During the war the Native Administrations became interested and communal swamp farming was tried, with mixed success. It became clear that communal farming did not appeal to local farmers. Accordingly, from 1945 onwards propaganda reverted to the settlement of individual farmers. A census taken in 1945 showed some 1,424 swamp farms in Kailahun District. The only remaining traces of communal farming are in some chiefdoms where the tribal authorities have caused small section swamp farms to be maintained against an emergency. In 1947, still working through the Native Administrations, a scheme has been started in Kenema District on lines similar to those successful in Makeni. Two Native Administrations between them have financed the clearing of 54 acres of swamp land which have been rented in one-acre lots to individual farmers.

46. *Cocoa.*—For several years instruction has been given in fermentation and in the care of plantations in this main cocoa area. Until this year, however, work has been handicapped by the low price. With the marked price increase, farmers have taken more interest. Two main troubles, due to war-time neglect, are the increase in "black pod" disease and monkey damage. Steps were taken to control black pod, whilst in a number of chiefdoms concerted drives have been made to lessen the monkey population. In one chiefdom, alone, over 3,000 monkeys were destroyed. It is proposed to institute full scale cocoa grading and inspection in the 1948/49 season and legislation is being drafted to that effect. Meanwhile, instructors have toured the cocoa areas giving advice in fermentation and preparation of the beans, and both farmers and traders have been given ample notice of what will be required of them under produce inspection.

47. *Coffee.*—Robusta coffee planting is extending steadily in Kenema District and coffee is now a valuable secondary cash crop. Various types of hulling and pulping machines are on trial and have been demonstrated to producers.

48. *Oil-Palms.*—Nurseries of Angola and Deli palms have been started. Although at present the supply of seedlings is limited, this should be remedied in the near future. Nongowa Chiefdom alone, has a nursery of 2,300 Deli seedlings whilst 1,000 seedlings have been planted out.

49. *Other Export Crops.*—For the first time, following negotiations with the United Kingdom Ministry of Supply, the oil-bearing seeds of the oil-bean tree (*pentaclethra macrophylla*) have been purchased. Locally they are known as the Fae bean, the trees of which are fairly common in high forest areas such as Kenema. The oil is suitable for soap, candles and as a lubricant. Purchasing was started at 2d. per lb. to the producer. The price proved popular and the tonnage bought (about 70 tons) was greater than was expected in the first year of buying.

50. *Soil Conservation.*—The soil conservation scheme in selected Kenema chiefdoms, started by the Forestry Department in 1945, has worked well. Compulsory reservation of hillsides through the Native Administrations is the basis of the scheme. Meanwhile the Agricultural Officer, Kenema, is carrying out a detailed study of the first chiefdom, Nongowa, which adopted this scheme. The detailed information so obtained should be of value when the expected soil conservation team is formed.

51. *Food Production Scheme.*—Concentration to improve the nutrition of an under-nourished population is being made in the eastern Kono chiefdoms. A seed farm is being opened there, planting material of rice and yams is being supplied and investigations are being made into farming practices with a view to their improvement. First findings seem to show that farming practices are at fault. This however, may be due to the same cause, namely, sleeping sickness, which formerly applied to the Kissi Chiefdoms. It may be possible that this disease is prevalent in Kono, making the people unable to carry out farming operations properly. This supposition, however, awaits confirmation.

Makeni

52. The main farm and sub-stations continued as demonstrations of improved methods of utilizing inland swamps and the surrounding uplands. Their other functions include the introduction and trial of new varieties of crops and the multiplication and distribution of proved varieties. They also serve as a training ground for junior departmental and Native Administration agricultural staff.

53. *Crops: Swamp Rice.*—The three British Guiana varieties, No. 79, D 99, D 114, were tried in addition to the established varieties, Sughandi, Lead, Ngasein and Panianala. Of these, Sughandi maintained its high yield but Lead and Panianala were both disappointing and the latter is to be discontinued. The results from the new British Guiana varieties were most promising and their short duration period should prove popular amongst local farmers.

54. *Other Crops.*—Collection, identification and growing of local cassava and sweet potato varieties were continued for comparison with imported strains. These two crops are of first importance in the dry season cultivation of swamps. So far, Mississippi is the highest-yielding sweet potato, giving up to 6,150 lbs. per acre under swamp conditions. Of the cassava varieties the local White and Biriwa strains are proving excellent. A small trial with coco-cassava, though not yet completed, indicates that the optimum yield is obtained some 9-10 months after planting. Trials with various legumes repeated over several years, have confirmed that the local popular preference for pigeon pea is well founded. Green gram is the most promising introduction. It has now done consistently well both on uplands and swamps but so far little interest has been shown in this crop by the local farmer. Three varieties of local groundnuts were tried but although yields averaged 721 lbs.

undecorticated nut per acre there were numerous barren nuts. General opinion is that this is largely due to too rich soil. Smooth Cayenne pineapple continued to do very well and is the best variety for this district. A small experiment comparing rate of growth and yield from different types of suckers confirmed that side suckers were better than head or root suckers.

55. *Swamp Fertility Maintenance, Observation Test.*—This experiment was started in 1945 using five swamp plots, each of which has a rainy season crop of Sughandi rice but each having a different dry season treatment. These dry season treatments are:—

(*a*) Fallow
(*b*) Native garden
(*c*) Sweet potatoes
(*d*) Cassava
(*e*) Maize and cow peas.

Immediately before each dry season cropping, the rice straw on half of each plot is burnt whilst on the other half the rice straw is buried. It is too early yet to reach definite conclusion but indications are that sweet potatoes in the dry season are beneficial to the following rice crop with fertility being fully maintained. In this treatment burning of the rice straw gives a marked increase over burying, both in the dry season sweet potato yields and in the following rice crop. In the fallow treatment burying of the rice straw gives a marked increase over burning. This may of course be due more to the humus provided by burying the grass which had developed during the fallow. These preliminary indications must, however, await future results before any definite conclusions can be drawn.

56. *Distribution of Planting Material.*—Fruit trees of many kinds, pineapple plants and seedlings of coffee, coconut and Angola oil-palm have been distributed from Makeni station to the total of 4,462 during 1947. The total since 1942, when the farm first began, is 23,411 plants. Most in demand are pineapple, coffee, coconut and Angola oil-palm, with bananas and sweet orange coming next.

57. *Extension Work.*—With three departmental sub-stations (Batkanu, Kabala and Makali) and with ten Native Administration seed farms throughout the area Makeni Agricultural Circle is well supplied with swamp demonstration and seed farms. They are first class demonstration farms. Kabala is developing into a promising vegetable-growing and cattle-training farm. At Makali, vegetable-growing and the raising of oil-palm seedlings for distribution are showing promise.

58. In addition to the seed rice and yams distributed from Native Administration farms, 1,637 bushels of rice and 7,027 lbs. of yams were distributed under the departmental revolving seed scheme. Since the scheme first began in 1940 at Makeni 14,674 bushels of rice and 47,501 lbs. of yams have been distributed for planting in that district. This scheme, having served its purpose, with ample improved seed now in the hands of farmers, will be reduced considerably in 1948. This will release instructors for the extension of swamp development on an increased scale in Makeni Circle.

59. The swamp development scheme in Makeni area, started in 1946 with funds from the Protectorate Mining Benefits Fund, has progressed successfully. A total of 127 acres of cleared swamps was cultivated by 93 individual lot-holders during the year. This compares with 55 acres in 1946. Two Native Administrations have voted money for this work and, with more instructors becoming available, there should be a marked advance in 1948. The most welcome feature of this scheme is that the results have every sign of being permanent. Rice yields per each individual plot have been uniformly good and the farmers respond well to the system. Results at Kamakwie are particularly encouraging.

60. *Ploughing.*—The small nucleus of Mandingo cattle owners in Biriwa Chiefdom who have become firmly established as mixed farmers, as described in the 1946 Report, have continued despite the current shortage of plough imports. It is hoped that 1948 will see this position improved.

Bonthe

61. Bonthe continued as the centre from which extension work in the southern littoral area is now directed. There is no experimental farm, work being concerned mostly with extension of rice cultivation in felled mangrove swamps, piassava production and inspection, surveys in the riverain grassland areas for potential large scale rice-growing and preliminary work on copra. Work in this area has been handicapped by difficulties in transport and communication. Communication is almost entirely by river and creeks covering many hundreds of miles. River transport is slow and the launch position, owing to delays in delivery of new vessels and engines, has not improved. As yet there is no cabin launch which is a necessity if an Agricultural Officer is to make detailed tours of the farming areas. Steps are being taken to provide such a vessel and it is hoped that it will be ready in 1948.

62. *Mangrove Clearing Loan Scheme.*—Felling of new areas during 1947 is estimated at about 500 acres, with a total of approximately 2,300 acres felled since 1939 in Bonthe District. Of this total less than half is actually in full rice-bearing. The process of clearing the felled trees and bringing the land into cultivation is thus a slow business. Work is now largely concentrated in two chiefdoms, Bendu and Imperi, where shortage of uplands is an incentive to mangrove clearing. Loans are being repaid reasonably satisfactorily and there is a steady demand for fresh advances. The most encouraging feature of this work is the way in which established farmers are extending their clearings voluntarily, but with the seeming impossibility of employing mechanical aids the work is bound to be lengthy and slow.

63. *Riverain Grasslands.*—During 1947 data was collected at two points, Gbap and Subu on the Sewa Waanji rivers, to give an idea of the periods and depths of flooding in this area, whilst details of local farming practice were obtained. A Rice Commission is expected to visit this district in 1948. If the right technique can be evolved, the possibilities of large-scale rice production in this area, recognised for many years, may become practicable but full surveys and detailed information are required before any accurate assessment can be made.

64. *Piassava.*—Instructional and inspection work continued during the year in Bonthe District but the drop in price in April from £75 to £43 per ton, and the increased price for palm kernels had a bad effect upon production. Also, as a result of past complaints regarding shipment of damp piassava, purchasing of piassava during the rains was prohibited. This probably added to the uncertainty of producers and adversely affected quantities and quality offered for sale at the end of the year. Total shipments of piassava from Bonthe during 1947 were 1,418 tons compared with 1,606 tons in 1946. Of these figures over 50 per cent was Prime Sherbro grade.

65. *Copra.*—Early in the year a sample of sundried copra, prepared at Gbap, was sent to the United Kingdom for a commercial report. This report was excellent and negotiations were made for commercial buying to start in 1947/48 dry season at a price of £40 per ton f.o.b. There are fair numbers of coconut trees along the Bonthe rivers with prospects of small supplies being surplus to local demands. Whether farmers will be satisfied to produce copra at the equivalent of ¾d. per coconut when the local selling price is sometimes as high as 1½d. remains to be seen.

Newton

66. This station is the agricultural centre for Freetown and the Colony area and Koya Chiefdom in the Protectorate. Its soil is typical of this over-farmed district and its work is largely concerned with experiments to conserve the uplands and to develop the swamps on an intensive market garden system. During the past two years Newton has rapidly developed into the most successful pig-breeding and pig-rearing station in the country. The Agricultural Officer, Newton, at present Mr. S. A. Roach, is also in charge of the two experimental areas of Maswari and Wellington where the study of reclaimed saline mangrove swamps is being undertaken.

67. Over a series of years, starting with the introduction at Newton of cattle and pigs in 1941, good progress has been made towards the evolution of a system of farming which satisfies the cardinal points of soil conservation, maintenance of fertility, ample food production and an economic return. This system is permanent tree crops and pastures, with cattle, on the uplands; intensive cultivation for rice and vegetables in the swamps and valleys using simple irrigation, contour ridges and compost; and European pigs as the chief revenue earners. It is a system eminently suitable for the Colony area and, with the demand for pigs increasing amongst reputable small holders, it is not too much to hope that gradually the complete system will be widely extended.

68. During 1947 the following were carried out for experimental and demonstration purposes: breeding and management of cattle, pigs, poultry, rabbits, guinea pigs and bees; soil and water conservation; use of valley land for rotational cropping with rice and vegetables, etc.; continuous preparation of manures and composts; raising of planting material in terraced beds for distribution; experiments to discover new vegetable varieties suitable for tropical conditions; continued efforts to discover suitable economic and marketable products that will grow on impoverished soil; "Lalang" control trials; establishment of pastures.

69. *Cattle.*—Starting in 1941 with two in-calf heifers from Teko and with the addition of four young cows and a young bull from the same source in 1942 the herd now totals 25. During the period 1941/47 culling has been carried out. This culling included suspected cases of contagious abortion in 1944 and 1945. This is the only serious complaint which has occurred amongst the herd and no further cases have arisen. The system of management is to milk the cows in the morning allowing the calves to run with their dams for the rest of the day. Under this system both dams and calves have done exceptionally well whilst, in addition, the surplus milk from the cows has been of benefit in the rearing of fowls and young piglets. An experiment in 1946 in the hand-rearing of calves showed that it was not successful at Newton. For general adult feeding since the laying down of Guinea grass and *Andropogon gabonensis* pastures in 1945 the animals have been fed entirely on free range pastures. Prior to 1945 they had been fed on silage but since then ample green grass has been available throughout the year and silage has not been necessary.

70. *Pigs.*—Pig-breeding was started at Newton in 1941 with an imported Berkshire boar which was crossed on to native sows, the idea being to improve the local pig. In 1942 nine pigs of mixed breed from the Gold Coast and eleven Large White strain from Nigeria were imported. By 1943 some 200 animals of mixed Berkshire-native and Berkshire-native Large White strains existed. These pigs were unthrifty, food was short and unbalanced, housing was poor, worm trouble was rife and mortality was high. In 1944 the whole scheme was revised. It became clear that the original idea of improving the native strain by crossing with exotic stock was not a success. It also became clear that feeding, management and housing needed complete overhaul. Accordingly in 1945 a new site was chosen on the highest part of the station. A modern prefabricated building was purchased from R.A.F. and erected on the new site. The stock was drastically culled to eliminate all native blood, whilst six well grown, good conformation gilts were purchased from the R.A.F. These gilts were of Berkshire Large White strain and probably originated at Newton in 1943. It is from this stock that the present very reliable sturdy Newton strain is derived. Rations were revised, utilizing to the full the cheap source of rice meal from the Government rice mill and introducing dried blood for the first time into the diet. This latter introduction, coupled with the elimination of native blood, has probably been the biggest factor in the success of pigs in Sierra Leone since 1945.

71. In 1946 Large Whites from Nigeria were imported. Although these have been prolific they have suffered from paralysis of the hindquarters in the females, usually a few weeks after farrowing. They are also liable to have insufficient milk

to raise a litter. Whether this strain has been too highly bred for size of litter at the expense of constitution or whether it is that other factors are present is not yet certain. It is noticeable, however, that both the Newton strain and the Njala Berkshire, so far, appear to be of better stamina, although less prolific, than the Nigerian strain.

72. Costs of pig production at Newton have averaged 6d. per lb. liveweight whilst price has been 1s. 3d. per lb. liveweight. During 1946 some 40 animals were sold for breeding and slaughter whilst in 1947 the figure had increased to 93 The basic stock had also increased from 62 to 102.

73. *Small Livestock*.—Rabbits, started at Newton late in 1944, have not done as well as expected. Deaths, the cause of which is not certain, have been frequent. Guinea pigs, also, have not yet shown any great promise. Work, however, will be continued with both these animals as they would be a popular small holders stock.

74. *Poultry*.—Poultry breeding with Rhode Island Red Stock was started at Newton in 1940 and an average of over 2,000 eggs have been produced annually since then. The average annual output per hen, however, has not been more than 50 eggs. Fowl typhoid and fowl pox have periodically caused heavy losses. Frequent new blood appears to be essential. Despite these handicaps to poultry rearing there is a continuous steady demand for eggs and birds amongst local farmers, and in 1947 some 555 eggs and 56 birds were sold for breeding purposes.

75. *Bees*.—Bee-keeping continued successfully in 1947 with twelve modern hives at Newton and two at Maswari. 149 lbs. of pure honey were produced, finding a ready local sale at 1/3d. per lb.

76. *Crops—Valley Cultivation*.—Steady improvement in the model valley smallholdings at Newton has been made each year since 1941. They are now first class examples of what can be done by simple improvement in water conservation. irrigation, contour bunding and the use of compost. Intensive cultivation has been carried out both during the rains and during the dry season, utilizing the valley bottoms largely for rice in the rains and for vegetables in the dry season, and the surrounding terraced slopes for fruit such as citrus, banana, pawpaw and pineapple. Varieties of all these crops which have proved best suited to the area are now well established whilst trials are still proceeding with a wide range of "European" vegetables. Amongst vegetables the most successful new introductions are Sutton's Patna cauliflower and Nigerian onions.

77. *Upland Cultivation*.—Work on the poor upland soil at Newton since 1943 has mainly consisted in attempts to bring the land back into fertility. With this end in view contour ridging with cross bars, grass planting and the establishment of permanent fruit trees using compost and fertilizers is the main basic system. An experiment was started on one acre in 1945 to see if degraded upland soil could be restored in fertility. The land was almost completely bare except for a growth of moss. An attempt to establish pigeon pea failed completely. Following this, at the beginning of the rains, the land was roughly contour-ridged and planted with the grass *Andropogon gabonensis*, using a light dressing of sulphate of ammonia and superphosphate. A thick mulch of cut grass and bush vegetation was laid between the ridges. By the end of 1946 the effect of this treatment was most marked, not only had the *Andropogon* established itself, but various annual grasses and weeds were growing between the ridges. The *Andropogon* grass has been continuously grazed during 1946 and 1947. With care in grazing and with the establishment of *Pueraria* during 1948 this land should be once again in good heart. Pastures of Guinea grass and *Pennisetum purpureum* were started in 1944. It was soon obvious that the Pennisetum was not a success but by concentrating upon Guinea grass and *Andropogon* some 20 acres of good pasture had been established by 1947. These 20 acres have, with care, stood continuous grazing throughout the year. At Newton, *Andropogon gabonensis* has proved superior to Guinea grass, both in growth and palatability—cattle and pigs preferring it. Another promising grass, as yet only in the trial and multiplication stage, is a *Setaria* from South Africa.

78. *Permanent Tree Crops.*—Small plantations of cinnamon and cashew, established for several years, have grown well, although yield from the cashew trees has been comparatively small. Samples of cinnamon bark and cashew nuts have been used for obtaining market reports but, with no future guarantee, no attempts have been made to extend cultivation of these trees amongst farmers. Citrus and grafted mangoes have done quite well and Avocado pears, at first disappointing, responded well to dressings of farmyard manure and, later, artificials. A danger was shown here, however, that it is possible to force fruit trees too much and, in the case of Avocado pears, overbearing could be harmful to the trees. Oil-palms do well once established but the first year after planting is a difficult period, termites causing considerable mortality. A nursery is maintained from which a steady distribution of a wide range of budded and seedling fruit trees has been continued over a number of years.

79. *Reclamation of Saline Swamps.*—The cleared mangrove area at Maswari some distance from the sea, has now been cultivated for rice since 1939, with varying success. It now appears, however, that provided bunding is used with discretion and the drainage is adequate it is likely that reasonable rice crops are assured in the future. In 1947, for the first time, local farmers were allocated plots within the empolder and they have been more than pleased with results. Yields during the past two years have averaged 1,300 lbs. paddy per acre, using the two varieties Sughandi and D 114, both of which appear to give equally good results and have proved superior to all other varieties tested at Maswari. Extension test plots in adjacent and more recently cleared mangrove areas were planted from 1945 to 1947 and from results it is clear that, with adequate drainage, soil conditions become progressively better as each year elapses after the original clearing.

80. At Wellington, which is immediately adjacent to the sea, and where the empolder is in fact a sea wall, conditions need considerable further investigation and, as at Maswari and in the Scarcies, are under intensive research by the Agricultural Chemist.

Teko Stock Farm

81. The untimely death of Mr. D. A. McBurney early in the year, was a severe blow to livestock research work in Sierra Leone. He was in his second tour in charge of this station and had inaugurated a long-term programme of work on sound lines. He had carried out the preliminary planning and siting of the new Animal Husbandry Station at Musaia and was expected to transfer Teko stock and material to Musaia at the end of the year and to take charge there. The maintenance of the work at Teko and the intricate business of starting Musaia have been ably carried on by Mr. A. S. Kerton, Development Officer, and Mr. E. S. Capstick, Agricultural Officer, Makeni, respectively. Work at Teko during the year is summarized as follows:—

82. *Cattle. Milk Records.*—Selective breeding work continued, with milk yields as the main criterion, on the lines laid down by Mr. McBurney. Figures show the steady improvement since 1944 due to selection and improved management:—

Year	*Total Milk Production*	*Average per Cow per Lactation*	*Total No. of Cows Milked*	*Average No. of Cows in Milk*	*Average length of Lactation*	*Birth of weight of Calves*
1944 ..	10,136 lbs.	390 lbs.	26	8	152 days	30.3 lbs.
1945 ..	12,356 „	722 „	16	9	203 „	34.1 „
1946 ..	13,955 „	1,077 „	18	8	337 „	35.0 „
1947 ..	15,925 „	1,108 „	18	9	294 „	35.4 „

83. *Fertility.*—During the year the fertility of the herd was adversely affected by an outbreak of coital exanthema in the bulls. Several cows became infected and the service record fell from 1.1 to 2.2. The Veterinary Officer recommended treatment which proved most effective and the fertility of the herd is again most satisfactory.

84. *Feeding Trials.*—A further ten experimental rations were given a trial with milking cows and calves. So far 62 rations have been tried out of which two are proving the best.

85. *Dairy Products.*—Using the Teko herd, small scale production of butter and cream has continued since it was first started in 1945, whilst 57 lbs. of cheddar cheese of very fair flavour were produced for the first time in 1947. Butter and cream production figures are:—

	Butter	*Cream*
1945 ..	332 lbs.	61 pints
1946 ..	239 „	62 „
1947 ..	266 „	67 „

This promising little venture has been invaluable in training staff for dairy work and once equipment becomes available a modest extension of production using local herds may be possible.

86. *Fly Worry.*—The practice of changing the bedding in the cattle pens frequently during the rains and collecting all dung from the yards has kept trouble from Stomoxys under control.

(*c*) Research

Plant Pathology

87. The Plant Pathologist, Mr. F. C. Deighton, O.B.E., was on leave from 16th May to 5th September, 1947. Mr. C. T. Pyne, Laboratory Assistant, was seconded for teaching duties at the Prince of Wales School from 23rd September to the end of the year.

The Plant Pathologist reported as follows:—

1. *Rice.*—The *Ephelis* disease of rice which first appeared at Rokupr agricultural station in 1946 again appeared there in 1947. The attack was less severe than last year. Atebubu was again the most severely attacked; and about 25 per cent of the panicles of this variety were infected, the fungus being first seen on 12th October, and the attack increasing especially in the first half of December. Konko and Sagbama varieties were attacked to a very small extent. Fortuno was not attacked this year. Other rice varieties remained free from the disease, as in 1946. It is now confirmed that the fungus is not the Indian species *Ephelis oryzae*, but *E. pallida*.

2. *Cacao.*—Severe outbreaks of Black Pod Rot (*Phytophthora palmivora*) were reported this year, especially from the Kokoru section of Gaura Chiefdom. Mealy Pod (*Trachysphaera fructigena*) was also common in the same area. It is possible that this is the result of lack of attention to plantations during the later war years.

3. *Cowpea.*—The *Aecidium* recorded in 1946 on a Ceylon variety of *Vigna sinensis* has been identified as the aecidial stage of *Uromyces vignae* Barcl., which is common in Sierra Leone on the wild *Vigna venulosa* but which had not before been seen here on cowpea, and has not yet been seen on any local cowpea varieties in Sierra Leone.

4. *Cucumber.—Pseudoperonospora cubense*, not previously recorded from Sierra Leone, was common on leaves of the cucumber variety "Cool and Crisp" grown at Njala from South African seed this year. This variety died out during the rainy season. No other cucumber varieties were attacked by this fungus.

5. *Minor records* of interest were: *Camptomeris albizziae* (Petch) Mason, on leaves of *Albizzia ferruginea* seedlings at Njala; *Cercospora hibisci* Tracy et Earle, on the wild *Kosteletzkya grantii* at Musaia; *Cercospora ipomoeae* Wint., on the common wild seashore plant *Ipomoea pes-caprae; Deightonia rhombispora* Petrak, on leaves of *Leptoderris brachyptera* at Sefadu; *Uromyces pseudarthriae* Cooke, on *Pseudarthria fagifolia* at Musaia; *Puccinia holosericea* Cooke, on *Lepistemon owariense* at Musaia; *Aecidium gynurae* Wakef. et Hansf., on *Gynura cernua* at Kabala; *Mycosyrinx cissi* (DC.) Berk., causing a common witch-broom growth on *Cissus afzelii*.

6. Forty-five collections of miscellaneous fungi and over 300 collections (including 180 by Mr. H. D. Jordan) of flowering plants were made during the year and despatched to the Commonwealth Mycological Institute and the Royal Botanic Gardens, Kew, respectively, duplicates being placed in the *Herbarium*.

AGRICULTURAL CHEMISTRY

88. With the arrival of the Agricultural Chemist, Mr. H. W. Dougall, at the end of June, the preliminary steps taken in 1945 and 1946 to re-establish this section of the department were completed. From July onwards, laboratory and field work was carried out on a full scale for the first time since the chemistry section closed in 1930. The Agricultural Chemist reported as follows:—

Scope of the Work Done

1. The preliminary work, started in 1946, to investigate soil problems which occurred in tidal-river areas empoldered for rice cultivation, was extended; routine analyses of crops and crop products were continued and expanded and some simple visual field experiments using compost and fertilizers were carried out at Newton.

Details of the Work done.—(Investigations into Soil Problems which have occurred in tidal-river areas empoldered for rice cultivation).

2. Mr. J. M. Dent, Agricultural Officer, who was responsible for the preliminary work in connection with these investigations, has published his findings in "The Empire Journal of Experimental Agriculture" (Vol. XV, July, 1947). The following extract is taken from the summary of his paper:—

"(1) Three soil factors, viz., excess of organic matter, excess of salt and a toxic concentration of iron sulphates, coupled with high acidity, are responsible either singly or in combination for total or partial failures to grow rice. The first two factors are relatively unimportant.

"(2) The presence of toxic iron compounds is associated with mangrove vegetation and these compounds are believed to be produced by oxidation of ferrous sulphide.

"(3) Toxicity due to iron compounds, as produced in areas of Avicennia mangrove, seem to be less lasting than toxicity in Rhizophora mangrove areas."

3. From observations made in the field during the period July to December, 1947, it can be stated that where rice fails to grow in empoldered areas, the following characteristics are invariably noted:—

(*a*) The soil to a great depth is intimately mixed with the fibrous roots of decaying mangrove, or an horizon of peaty humus of varying depth overlies a blue-grey or a yellow clay.

(*b*) The ground-water table during the rainy season (June–November) is either at the surface of the soil or only a few inches below it.

(*c*) The ground-water is astringent, sometimes brackish to taste and may be reddish-brown in colour.

(*d*) A ferruginous scum appears at the surface of the soil.

(*e*) That portion of the rice plant below the surface of the soil is always heavily coated with a black deposit of ferrous sulphide.

(*f*) The drainage appears to be most inadequate. It does not allow percolation downwards through the soil of either the heavy rainfalls or the non-salt tidal water (which is admitted to irrigate the rice). It also allows for insufficient lateral movement of ground-water.

(*g*) The soils within the empolders are inefficiently aerated.

4. From the results of chemical analysis obtained since July, it can be stated that:—

(*a*) The soils are ferruginous (12–15 per cent oxides of iron).

(*b*) The iron content and the sulphate content of the ground-water is high (0.5–0.8 per cent oxides of iron) and (0.25–1.4 per cent SO4).

(*c*) There can be a high concentration of chlorides (0.99–1.5 per cent).

(*d*) The soils are very acid and the ground-water is very acid (pH 2.8 to 3.8)

(*e*) Hydrogen sulphide and ferrous sulphide are produced under the anaerobic conditions which prevail.

(*f*) Where the pH of a soil within an empolder is greater than 5.5 rice appears to grow satisfactorily.

5. It would appear that the retrogressive soil changes which have occurred after empolderng tidal-river areas are a result of ineffective aeration of the soil, accentuated by an insufficient regard to drainage conditions.

6. It must be noted that in the tidal marginal swamps of the river plains an excellent natural drainage system exists in the form of creeks and subsidiary creeks. Where empoldering has been carried out in these areas the natural drainage has been replaced by a far less efficient system from which water-logging has ultimately resulted.

7. On the other hand, areas inland from the swamp behind the marginal lands of the river plains have always been inefficiently drained and aerated. They are not influenced to any extent by creeks nor have they any efficient means of distributing or disposing of the run-off and seepage-water from the surrounding hills. In some parts of such areas the land is water-logged throughout the year. The horizon of peaty humus of varying depths which occurs beneath the vegetation cover indicates that these areas have been subject to reducing conditions for a very long time. Where such areas have been empoldered the conditions described have not been substantially altered.

8. It is as yet uncertain whether the high concentrations of iron in the soil are caused by naturally occurring deposits of pyrites or marcasite. This may be so, but the effects of drainage and seepage-water in carrying in solution silica and bases leached from surrounding hills, and the redistribution of these bases over areas now empoldered, must not be ignored.

9. There can be little doubt that the fibrous roots of decaying mangrove and the horizons of peaty humus absorb water very quickly at the beginning of the rainy season, and a rapid rise in the ground-water table occurs. By virtue of inadequate drainage neither rain water nor irrigation water can penetrate downwards through the soil, nor can the ground-water move laterally into the drainage channels.

10. Under the anaerobic conditions which are created, sulphates—e.g. ferrous sulphate—are reduced to sulphides by the hydrogen sulphide produced from the decaying mangrove and the humus. Some of the ferrous sulphide is deposited on the rice plant immediately transplanting is carried out. The acid ground-water, containing in solution ferrous sulphate and hydrogen sulphide, together with the ferrous sulphide contribute to cause the death of the rice.

11. Observations of the effect of the dry season on soil conditions are still in progress, but those made up to the end of December can be summarised as follows:—

The rains ceased early in November and by the end of December the ground-water level had been lowered 12-18" in all empolders.

12. As the level of the ground-water falls the soils dry out quickly (surface temperature 110° F) and the first stage of the "drying out" process is the formation of a ferruginous crust on the surface of the soil. With further drying, cracks appear in the soil and air is liable to penetrate the cracks produced. Some of the iron in solution in the ground-water is oxidised and separates out at depths coincident with the fall in the ground-water table. The sulphides of iron are at the same time oxidised to sulphate.

13. Under the conditions of heavy rainfall—about 110" *per annum*—in these areas, as well as with the non-salt tidal river water which can be readily admitted into the empolders, washing out toxic substances in solution in the ground-water should present no major problem provided drainage is adequate.

14. The programme of work in empoldered areas for 1948 is therefore based on improving drainage conditions, water control and also producing better aeration in the soil. Plans are already well advanced to achieve these objects and a drainage system has deen designed to:—

(*a*) Remove toxic substances in solution from the soils.

(*b*) Remove saline water from the soil (should it be present).

(*c*) Allow the slow, downward percolation of oxygen-charged water through the root range of the rice plant.

(*d*) Permit the lateral movement of ground-water into the drains.

(*e*) Allow for retaining non-salt river water for irrigation during the dry season.

15. It is anticipated that once success is achieved in all objects enumerated above, the next step will be the amelioration of soil acidity either by the use of lime or ground oyster shells (which can be found locally) and the building up of soil fertility by making use of compost, green manure and probably fertilizers as well.

Routine Analyses

16. The results of analyses of some of the various samples which have been submitted by Agricultural Officers during the year are recorded below:—

Kono groundnut (Makeni) ..	47.97 per cent oil 7.95 per cent moisture
Native groundnut	46.34 per cent oil 7.39 per cent moisture
Po-Yok (Njala)	31.90 per cent oil
Palm Oil (Njala)	11 per cent free fatty acid
Tobacco (Makeni)	0.776 per cent nicotine in air dry sample (moisture 8.94 per cent).

17. Analysis of oyster shells, which occur in the Colony Peninsula, gave 42 per cent CaO. The possible use of this material either as a source of lime in plant nutrition or in the feeding of livestock is being investigated.

Visual Field Experiments

18. In July, three visual field experiments were laid out at Newton to study the effects of compost and fertilizers on the growth of:—

(i) Rice

(ii) Pueraria

(iii) Panicum laxum.

The soil at Newton is very light, sandy and well drained. The pH is 5.6–5.7.

Experiment 1—Rice

19. Sulphate of ammonia, muriate of potash, superphosphate and compost were used in this experiment. The fertilizers were applied at rates equivalent to 5 cwt. per acre and the compost was applied at a rate equivalent to twenty tons per acre. The fertilizers were used singly, mixed, and in combination with compost. They were applied at the time of transplanting the rice (28th July, 1947) and were incorporated in the soil by hand forks.

20. The plots were irrigated daily by fresh water in addition to receiving the normal rainwater which fell.

21. Where compost had been supplied the growth of the rice plants was vigorous. They were stronger in both root and stem than rice growing in untreated soil. Potash or phosphate separately appeared to produce the same effect as compost and it was impossible to assess the value of the one over the other by the eye alone. Composts and phosphate in combination were superior to either compost alone or to phosphate alone, and the potash with compost was superior to compost alone or potash alone. Sulphate of ammonia when applied alone produced very little response. When applied in combination with compost and potash better results were obtained than when applied with potash alone.

Experiment 2—Pueraria

22. Sulphate of ammonia, muriate of potash, superphosphate and basic slag were the fertilizers used in this experiment. They were applied singly and in combination. Compost was also used alone or in combination with fertilizers.

23. Pueraria had been planted in ridges approximately 2′ 6″ apart and 9″ high in early July. At the time of application of the fertilizers and compost (28th July, 1947) the pueraria was about one inch above the ground. The method of application of fertilizers was by placing them around and below the roots of the pueraria without allowing them actually to come in contact with the roots.

24. Results of observations of this experiment showed that compost alone had good effect and when applied in combination with potash, superphosphate, slag or sulphate of ammonia, it is superior to these fertilizers applied alone. Phosphate (as basic slag) in combination with compost appeared to give better results than superphosphate in combination with compost. Sulphate of ammonia, applied alone, was useful but its effect was more marked when applied with basic slag. Potash gave good response when applied with compost. The best treatment appeared to be the application of compost with the addition of sulphate of ammonia, potash and basic slag. More even growth was obtained and a good cover of broad-leaved material was obtained.

Experiment 3—Panicum Laxum

25. The same kinds of fertilizers and compost were used in this experiment as in the previous experiment. Fertilizers were applied at rates equivalent to 5 cwt. per acre and compost at the rate of 20 tons per acre. Fertilizers were applied on the 28th July and the grass was planted by hand on 29th July. Observations showed that although the application of compost produced good growth of grass, many weeds appeared. The fertilizers, applied singly and in combination gave disappointing results except in the case of a mixture of potash, basic slag and sulphate of ammonia. Compost with potash and phosphate was superior to compost and potash and to compost and phosphate (as slag). Compost in combination with potash and phosphate (as basic slag) gave the most promising results.

26. The experiments described were primarily originated to form a basis for further work. Their limitations are obvious and any deductions made from them most certainly require to be supported by statistical experiments.

27. It would appear however, that at Newton, with its light, sandy soil, the extensive use of compost must be the basis of improving soil fertility. There can be no doubt that phosphates and potash are of definite value, but it appears that they may be more beneficial when applied with compost than when applied singly or in combination with the other. The value of sulphate of ammonia has not been assessed and its role merits much further study.

ENTOMOLOGY

89. The Entomologist, Mr. F. A. Squire, was in charge until he went on leave on 4th October, 1947. During the rest of the year the routine duties of the section were carried out by Mr. J. S. Wellington, the Senior Laboratory Assistant. Six extended treks to various parts of the country were made by the Entomologist during the year to carry out investigations on insect pests of stored produce, cattle pests particularly tsetse fly and several pests of crops. The Entomologist's report is as follows:—

Agricultural and Horticultural Pests

1. *Rice*—Continues remarkably free from insect pests of any consequence, although the insect population of rice fields is high especially in Orthoptera and Hemiptera. There was the usual occurrence of *Heteronychus* during the rains near Gbap, in the Bonthe District.

2. A Pyralid stem-borer was reported attacking swamp rice in the Makeni District by the Agricultural Officer. This has only once previously been recorded viz., by Hargreaves in 1932 at Makumba. Evidently the insect is very effectively kept down by parasites.

3. *Benniseed.*—Benniseed (*Sesamum indicum Linn.*) was severely attacked during the rains in September at Njala by a gall-forming Cecidomyid. The attack was reported from the Njala Training College. The first symptom seen is the characteristic curving of the stem near the top. Galls appear all over the inflorescence and upper part of the stem, resulting in complete necrosis and putrefaction. Practically every plant in a field was attacked and killed or rendered useless. Fortunately this destructive pest has never been seen elsewhere in Sierra Leone, nor has it been recorded from other parts of West Africa.

4. *Yams.*—The Chinese yam, *Dioscorea esculenta*, is a popular and widely cultivated root crop in Sierra Leone. Unfortunately the tuber-root is subject to attack by microscopic round worms known as plant nematodes or eelworms (*Heterodera sp.*). The symptoms of the disease are warts on surface of the tuber-roots and rotten patches inside. In severe cases the whole yam putrefies and a large proportion of the crop may be lost.

5. The worms are capable of remaining alive in stored yams for many months, so that it is important to select only sound tubers for planting. But there is another factor. Eelworms can also carry over in the soil for several years. So that even if sound planting material is used, care must be taken to plant it in clean land. A common practice in Sierra Leone is to plant Chinese yams in the same trenches year after year. There is no objection to this practice normally, but the crop should be carefully examined every year for warts and rotten patches in the tubers. As soon as the first sign of these symptoms is seen, the planting material for the next crop should be carefully selected and new trenches dug. The old trenches should not be used for yams again for at least three years though, of course, other crops may be grown there.

6. *Maize.*—Considerable damage was done to maize grown at Njala on low-lying land during the dry season by a species of *Macrotermes*, the workers of which operate underground, destroying the roots and collar of the plant, so that the damage is done by the time symptoms appear. Maize was also heavily attacked at Njala by the stalk borer, *Busseola fusca* Fuller.

7. *Black-eye Bean. Bruchus ornatus* Boh., heavily infesting black-eye beans (*Vigna sinensis*), was parasitised by the minute wasp, *Aplastomorpha Calandrae* Howard. This parasite was recorded by Hargreaves on the rice weevil.

8. *Mango.*—Seedlings were severely damaged at Newton and at Njala by the Coreid bug, *Anoplocnemis curvipes* F. The growing point is severely damaged, giving rise to cankers and sometimes many of the younger leaved are severely damaged. The insect is numerous throughout the dry season and well into the rains and attacks a great variety of wild and cultivated plants, but has a strong predilection for mangos, especially young budded stock in nurseries. It occurs throughout West and West Central Africa and presents a fine example of phoresy: a tiny wasp, *Microprophanurus* sp , is generally to be found perched on the female's thorax and is a constant associate. If driven off by the observer, it will hover about and come to roost in its accustomed place. During oviposition the wasp runs down the bug's back and deftly punctures each egg as it is extruded, thus parasitising them. Unfortunately this parasite is less active in Sierra Leone than in other parts, whereas the host is rather more numerous.

9. Two Cetonid beetles were recorded severely damaging the inflorescences of grafted mangos at Newton. They are *Pachnoda marginata* Drury, a large black species with yellow margins, and *P. marginella* F., a brilliant green beetle. Both are generally found together in clusters on the inflorescences which they render quite sterile as the result of feeding on the flowers, flower stalks, main axes and branches of the inflorescences. There are two other beetles of the same genus recorded from Sierra Leone, viz., *P. cordata* Drury and *P. postion* P. de B.; all of them are attracted to flowers and fruits and cause severe loss of crop.

10. The Bostrichid beetle, *Apate monarchus* F. was recorded at Njala severely damaging a mango tree with a trunk of 3″–4″ diameter. The tree was not only alive but apparently in good condition. Yet the trunk was riddled with the tunnellings of the beetles.

11. *Guava.*—The same insect was also observed in great numbers occupying the trunk of a young guava tree. This family of beetles generally attacks only dead trees or felled timber. In both the cases mentioned the attack took place during the dry season, and it is likely that the low moisture content of the wood proved attractive to the beetle.

12. *Anona muricata.*—The soursop is heavily infested with a medium-sized red-headed ant not previously recorded from Sierra Leone, which nests in hollowed branches killing them and weakening the tree generally. It also fosters the scale *Stictococcus* sp. on the fruit. Another ant, the sooty *Camponotus acvapimensis* Mayr., does not nest on the tree but attends the even more destructive Membracid, *Hilda undata* Wlk., on the flower buds causing them to drop off, and on the fruits causing deformity and rotting

13. *Cashew.*—The Cerambycid beetle, *Diastocera trifasciata* F., was observed girdling cashew trees at Pujehun and at Njala. In the case of young plants the stem was severed causing total loss, while in older trees branchess up to 2″ in diameter were attacked and killed. Other hosts of this insect are *Spondias monbin* Linn. of the same family as cashew and, according to Hargreaves, eucalyptus. The latter author also records it as a general girdler of trees.

Forestry Pests

14. Seedlings of *Sarcocephalus diderrichii* de Wild at the Forestry Department nursery at Kenema were damaged by the Coreid bug, *Dilycœtha tenuicornis* Berg. All stages of the insect were found, including the eggs which occurred in small clusters on the underside of the older leaves. Both the nymphs and adults attacked the growing tips and younger leaves, causing necrosis round the site of the punctures.

15. *Terminalia ivorensis* A. Chev.—This tree was attacked by a Cerambycid bark beetle near the bases of the boles. The larvae feed on the inner portion of the bark and on the adjacent soft wood. By the time the larva is full grown the area affected may be the size of a saucer. The bark becomes soggy, is easily depressed and gummosis is evident. Attempts to breed the larvae through to the adult stage were unsuccessful, so that a determination could not be made, but two species of Cerambycids suspected are *Plocederus basalis* Gahan. and *Xystrocera femorata* Chev. Following this damage, the ant *Camponotus maculatus* F. was found to gain access to the woody cylinder of the tree through the exposed area where the dead bark had sloughed off, and established itself there severely damaging the tree.

16. *Octhocosmus africanus* Hook. f. was attacked by the same ant which established itself in the bole so that the wood for about six feet from the roots upwards was completely riddled with galleries. The only external sign of attack was the presence of exit holes at irregular intervals on the bark.

17. *Alstonia macrophylla* and *Peltophorum ferrugineum*.—Hundreds of cocoons of the Lymantrid moth, *Orgyia vetusa* Hmps., were observed in clusters on the bark and leaves. In the caterpillar stage this moth is a defoliator of these trees.

18. *Mitragyna stipulosa* O. Kuntze.—Both surfaces of the leaves were covered with dense masses of bright green warts, turning brown from the centre of the patches outwards as the tissue is killed. This proliferation was caused by a mite which was found in the folds of the galls. The latter thus afford the mite shelter as well as abundant and succulent food. The mites are found mostly in the older galls and are very numerous. A few square millimetres of leaf surface yield hundreds of mites in all stages of development—the full grown individuals measure approximately 0.1 mm. in length.

19. *Homalium dolichophyllum* Gilg.—Trees at Njala are infested with a gall-forming Chalcid causing spherical galls a little larger than a pea on the distal branches. The eggs are laid under the bark, and by the time they hatch there is sufficient proliferation of the soft cortical tissue for the larvæ to feed on. Pupation takes place in a chamber just below the epidermis which is ruptured on emergence of the adult.

20. *Chlorophora excelsa* Benth. and Hook. f. was defoliated at Kenema by caterpillars of the Saturniid moth, *Nudaurelia dione* F. Leaf galls, especially on young shoots from cut-back plants, were very common at Njala. These were caused by the Psyllid, *Phytolyma lata* Wlk.

21. *Bombax buonopozense* P. Beauv.—Young trees of this species were found heavily infested with large Cerambycid borers in the trunks and branches at Kailahun during the dry season. Some 15-feet trees were almost killed off by this pest.

22. *Cassia* spp. at Njala were heavily infested with the carpenter moth, *Xyleutes polioplaga* Hamps., the larvæ of which tunnel through the pith and heart wood. As the full grown larva is 3 inches in length and over half inch in thickness, and as the tunnel is of proportionate dimensions, it will be seen that the structural damage to the branches is considerable, although at this stage the tree does not appear to suffer. Later, however, the emergence of the moth from the pupal chamber just beneath the epidermis exposes the mine with the result that moisture gathers in it and causes rotting.

Ornamentals

23. *Thespesia lampas* D. and G. at Njala was infested during the latter part of the dry season with the cotton stainer *Dysdercus superstitiosus* F. These evidently spread from *Sterculia tragacantha* Lindl. which fruits early in the dry season, and which is heavily infested with this species every year. A vast population breeds upon the fallen *Sterculia* seeds and nymphs readily cluster on to ornamental shrubs in the vicinity for the sake of the moisture in the tissues. *D. antennatus* Dist. was observed on *Berrya ammonilla*, an introduced Tiliaceous tree within 50 yards of an infested *Sterculia* tree, but it is of interest to note that Berrya was not attacked by *D. superstitiosus*.

24. The Melolonthid beetles, *Trochalus gibbus* and *T. carinatus*, were recorded as pests of roses at Newton early in the rains when they occurred in great numbers.

Pests of Vegetables

25. Okras, *Hibiscus esculentus*, were attacked by *D. superstitiosus* F. which was preyed on by a remarkable Reduviid mimic of *Dysdercus*, *Rhinocoris tibialis* St. The okra leaf-roller *Sylepta derogata* F. became fairly numerous. Cucurbits were damaged by the Galerucid beetle, *Leptaulaca vinula* Er., and the Coccinellid, *Epilachna chrysomelina* F.; pole beans by the Coreid, *Riptortus tenuicornis* Dall.; and the Pentatomid, *Brachyplatys æthiops* Dall.; and sweet potato leaves by the Cassidid beetles, *Laccoptera corrugata* Sahl. and *Aspidomorpha* sp. It is of interest to note that no fewer than fifteen species of *Aspidomorpha* have been recorded from Sierra Leone.

Storage Pests

26. Conditions of storage for agricultural produce still leave much to be desired and improvements are likely to be slow owing to the shortage of building materials. Most of the common pests are listed by Hargreaves (*Some Insects and their Food Plants in Sierra Leone*, 1937). The following may be added:—

Coleoptera

Tenebrionidæ:

Alphitobius lævigatus F.—Cocoa, rice and beniseed.

Lamiidæ:

Sophronica ealeata Cher.—Coffee

Lepidoptera

Pyralidæ:

Ephestia cautella Wlk.—Palm kernels.

Apart from the insanitary conditions of storage the problem is aggravated by the delays during internal transit and shipment.

Pests of Medical and Veterinary Importance

27. *Tsetse fly.*—The distribution of the three species of tsetse fly in Sierra Leone was determined by Simpson (1914) and Frew (1929). Later, Harding added to this knowledge and Nash and Walton (1945) in a brief survey made further contribution which fits in well with what was known. The distribution of the tsetse species has therefore been well worked out, and it was decided that there is little to be gained by going over the same ground. On the other hand very little is known concerning the habits of the flies in Sierra Leone so that this was made the subject of investigation. The results will be discussed under the following headings: breeding habits, feeding habits and their relation to man and livestock.

28. *Breeding habits—Glossina palpalis.*—This species breeds along wooded streams, swamps or estuaries in every part of Sierra Leone. Breeding is at a low level during the dry season and rises during the rains, so that the highest population is recorded in June, July and August. By this time, however, many of the puparial sites become inundated by the rise in the level of the water courses. Towards the end of October the dry season shelves are re-colonised and there is a secondary population-peak at the beginning of the dries in December and January. The severity of the latter part of the dry season is evidently very unfavourable to the fly as it becomes very scarce in March and April. This naturally varies in different parts of the country according to rainfall and the nature of the country. Thus, in the drier North at Musaia for instance, where the rains are short and where there are comparatively few large rivers, the fly population peak periods are of short duration and the fly is scarce for five months of the dries, whereas by contrast along the great estuaries of the coastal belt where the rainfall is higher and where the dry season is more temperate, there is a much shorter low population period.

29. Diurnal fly activity appears to be regulated by air temperature On hot sunny days at Musaia the flies were active by 9.30 a.m. in the fringing forest which they never leave, and vanish by midday to reappear in smaller numbers in the late afternoon. This may be contrasted with the Bonthe District, say during the heavy July rains where on cold wet days the flies are not seen until 1 p.m. and continue active until about 5 p.m., roaming far from the fringing forest. Rain in itself does not deter them since they were repeatedly observed coming aboard the launch in midstream in dozens during heavy rain in the early afternoon.

30. Mating takes place during the period of diurnal activity, whilst at rest, and copulating flies may be captured and observed. Copulation lasts for an hour or more, and the flies are far less restless and jumpy than ordinarily. The male perches on top of the female's back and firmly secures the apex of the abdomen with the clasper shield.

31. Regarding the actual puparial sites, there is again a good deal of variation within Sierra Leone. Wherever there are young oil-palms near water the puparia will be found round their bases. The close association between *G. palpalis* and *Elæis* was first recorded by Warrington-York and Blacklock in 1915, and formed the ecological basis of very effective control measures against the fly in the Colony Peninsula. In the north where palms are very scarce and do not enter into the composition of fringing forests, the trees mainly associated with tsetse are *Uapaca heudelotii* Baill. (*Euphorbiaceæ*) Yalunka YALAGENA; Mende KUNDI, which is very common along the streams, especially on the dry season shelves where it favours tsetse breeding on account of its recumbent attitude. Another tree of similar habits and associations is *Maba mannii* (*Ebenaceæ*)—Yalunka PFOTOTORN; Mende SI. The association is, however, not so remarkable and exclusive as that between tsetse and oil-palm. Concerning the habits of *Glossina fusca* and *G. longipalpis* in Sierra Leone nothing is known and there is very little information available to add now. The distribution of *G. fusca* is generally speaking coincidental with high forest, but this may not be a direct casual relationship. *G. fusca* is common in the Makeni District and even at Fintonia, which is altogether outside the high forest area at the present time. Other factors are evidently involved. *G. longipalpis* has a puzzling distribution. It is a savannah species, but is absent from certain typical *longipalpis* areas such as Musaia. The only likely explanation is that it has a more obligatory association with game which retreated from those areas opened up by roads. At Fintonia the three species were found together in the following proportion:—

G. longipalpis	45
G. palpalis	2
G. fusca	1

The country there is undeveloped and is reputed to have a lot of bush cow, elephant and other game. A remarkable fact concerning *G. longipalpis* in this area, and one which apparently does not support what has gone before, is that the fly is most numerous all along the one and only road in this area. Unfortunately attempts to locate the breeding places in this area were not successful.

32. *Feeding habits—G. palpalis.*—Where the opportunity occurs, for instance at bathing and watering places and in riverine villages, this species feeds readily on humans; yet there is no concentration of the fly near villages, but on the contrary it is often scarce near large towns. In the Bonthe District the biggest catches were made in places remote from human habitations.

It is therefore certain that in many parts of Sierra Leone humans are not the main food source. Game is excluded on similar grounds in many areas, although they are important in others. This leaves crocodiles and other reptilia, monkeys, small animals and birds. Unfortunately it is very difficult to determine the importance of these by direct observation. In villages the fly has often been observed feeding on goats, sheep, cattle and pigs. The latter appear to be favourite hosts. Attempts were made to classify the blood of newly-engorged flies by microscopic examination, but the data obtained was too meagre to form the basis for any conclusions.

33. In the case of *G. fusca* and *G. longipalpis* practically nothing is known for certain, but from ecological considerations it is probable that wild animals play an important part in providing food for the fly. According to Frew (1929) *G. fusca* is often associated with bush cow. *G. longipalpis* is limited to the most undeveloped parts of the North where elephant, bush cow and other game are known to abound and is strongly associated in the native mind with these animals. Certainly this species frequents the orchard bush and even open grasslands, so that it is ecologically closely associated with game, whereas *palpalis* and *fusca* normally keep to the fringing forests. Here *fusca*, owing to its crepuscular and even nocturnal habits might easily feed on game, visiting the streams at dusk and at dawn. With *palpalis* this is most unlikely since it is not active at these times of the day.

34. *Relation to Man and Livestock.—G. palpalis.*—Nearly every village in Sierra Leone has a watering place at no great distance. Moreover much farming is done near the rivers and swamps and to that extent everyone comes in contact with *G. palpalis*, even though it does not actually come into the villages. But there are innumerable small settlements on the river banks all over the country, and here, during the fly season, flies may be taken in considerable numbers actually in the villages and in the houses. At times they will travel several hundred yards from the water through intervening scrub bush to the houses. Here they feed on domesticated animals as well as on humans to a lesser extent. The people are not in the least concerned about the fly and do not appear to believe that they are associated with sickness. This is not surprising since there is in fact very little trypanosomiasis in man and animals, except in certain areas. Surveys made in riverine villages have failed to produce a single case with trypanosomes, even in such susceptible animals as pigs.

35. In the north at Musaia, Sinkonia and Falaba, both the Yalunkas and Fula herdsmen say they do not know of any disease of cattle resembling trypanosomiasis and regard the tsetse (Yalunka KGENNA; Fula LOLE) as harmless. They are far more concerned about the tabanids (Yalunka SIGINA; Fula GURWABI) which they say inflict painful bites on their cattle and cause them to stampede. In this country *G. longipalpis* is very scarce. Yet about 60 miles to the west *G. longipalpis* is common and here there is a very different story to relate. The people at Fintonia state that cattle cannot be kept in those parts and even animals in transit from French Guinea will sicken and die if held any length of time. This they attribute to the presence of bush cow. Where there is bush cow they say cattle cannot survive. They do not accuse the tsetse (Susu KGERRI; Limba POLLO), but neither do they dismiss it the way the Yalunkas and Fulas do. They say the fly is numerous at all times, but particularly in the dry season. This is in direct opposition to what we know of *G. palpalis*. Certainly the fly was numerous enough when this district was visited in the rains (August–September). It is proposed to visit it again in the dry season to verify this statement.

36. Regarding *G. fusca* there is no information on this score.

37. *Stomoxys*.—The following species occur in Sierra Leone. *S. calcitrans* L., *S. nigra* Macq., *S. omega* Newst., *S. brunnipes* Grunb. and *S. pallida* Roub. Of these the first two are the commonest. They feed at all times of the day and on all parts of the animal, and are a source of continual irritation. Moreover, they tend strongly to concentrate on the sick and lame of the herd and can kill them in a few days. Their possible importance as mechanical vectors must also be remembered, though there is no precise information on this subject in Sierra Leone.

38. The peak season is in the height of the rains in July, August and September, and this is due to the fact that their favourite breeding place is dripping wet stacks of grass, compost or manure and even in old or mouldering grass thatching. In the northern cattle country *Stomoxys* is deemed very harmful to cattle.

39. *Tabanids*.—In the cattle country round Musaia both the native Yalunkas and the inquiline Fula herdsmen state with one accord that this is the most noxious fly known to them because it inflicts painful bites on the cattle and causes them to stampede. It is called SIGINA in Yalunka and GURWABI in Fula. Only one species *Tabanus tæniola* P. de B. was taken, and that was common but not numerous. This was before the start of the rains, however, which generally brings out the Tabanids. During the rains at Newton the following species were taken attacking animals—*T. pluto* F., T. *fasciatus* F., *T. tæniola* P. de B. *T. par* Wlk. and *Hæmatopota grahami* Aust. In the estuarine coastal country in the Bonthe District during the heavy rains a curious ecological repartition of species was observed. *T. fasciatus* F. was common wherever there were large clearings along the banks and was very numerous on the grassland area near Gbap. In the transitional bush between grassland and mangrove, a large brown Tabanid not previously recorded in Sierra Leone was the common species, while in the mangrove vegetation both the Tabanid species were scarce and tsetse flies became numerous.

40. Another Tabanid that merits special mention is *Chrysops longicornis* Macq. It is the only *Chrysops* recorded in Sierra Leone and is evidently rare. For this rarity and the apparent absence of the other West African species of *Chrysops*, we have to be thankful since this is the fly responsible for the widespread occurrence of filariasis in south-eastern Nigeria.

Population Studies at Njala

41. Light trapping was in progress most of the year. The main object was to study the species present at different seasons. At the same time it was hoped to trap insects not hitherto recorded in Sierra Leone. Altogether some 350 species were taken, of which 143 were not represented in our collection. As was to be expected the Lepidoptera predominated. Of the 350 species 232 or roughly 66.3 per cent belonged to this order. The rest was nearly equally made up of Orthoptera, Hemiptera and Coleoptera, with a few Diptera, Isoptera and Hymenoptera.

42. During the dry season the catch was mainly Orthoptera, Hemiptera and Coleoptera. Lepidoptera did not commence until the first rains at the beginning of March, after which they increased rapidly and remained predominant throughout the rains.

43. The following analysis into families may be of interest:—

Orthoptera	*No. of Species Taken*
Acrididæ	2
Tettigoniidæ	10
Blattidæ	2
Gryllidæ	10
Mantidæ	4
Total	28

A few species need special mention. The Acridid, *Loxilobus bantu* Rehn. occurred in considerable numbers towards the end of the rains, but was not recorded at all before the end of September. The Gryllid, *Gymnogryllus miurus* Sauss. was very numerous in March after the first rains and then disappeared.

Hemiptera	*No. of Species Taken*
Cercopidæ	4
Cicadidæ	1
Coreidæ	3
Dictyopharidæ	3
Flatidæ	2
Pyrrhocoridæ	1
Jassidæ	2
Pentatomidæ	3
Reduviidæ	1
Tropiduchidæ	1
Total	21

Coleoptera	*No. of Species Taken*
Bostrichidæ	1
Cerambycidæ	4
Copridæ	2
Drilidæ	1
Elateridæ	1
Dynastidæ	1
Endomychidæ	1
Eumolpidæ	1
Meloidæ	1
Melolonthidæ	1
Parnidæ	1
Rutelidæ	4
Tenebrionidæ	4
Cassididæ	2
Carabidæ	1
Total	26

The Tenebrionid *Lyprops rugatulus* Frm. was taken in great numbers during March and then disappeared completely.

Lepidoptera (Heterocera)	*No. of Species Taken*
Arctiidæ	7
Bramæidæ	1
Cerulidæ	1
Cossidæ	2
Ectotropidæ	1
Eupterotidæ	4
Geometridæ	11
Hypsidæ	3
Lasiocampidæ	3

Lepidoptera (Heterocera)	*No. of Species Taken*
Limacodidæ	7
Lymantridæ	15
Noctuidæ	9
Notodontidæ	7
Pyralidæ	25
Saturniidæ	11
Sphingidæ	16
Syntomidæ	8
Tineidæ	1
Total	132

In addition to these 132 species another 100 species were taken which are not represented in the collection. Amongst the remaining orders there were 43 species not previously recorded in Sierra Leone.

44. The Hypsid *Phægorista agaristoides* Boisd. was very common for a few nights towards the end of March and then disappeared. The fruit piercer *Achæa catocaloides* Guen. was taken during March, April and May.

Termite Studies

45. *Cubitermes silvestrii* Sjost. and *Cubitermes* new species near *bilobatodes* Silv. in coffee plots at Njala, common in scrub bush everywhere. They feed on the forest carpet and may be seen everywhere covering fallen sticks and other detritus with mud casts. The beating of soldiers' heads causes a rustling sound as one disturbs them by walking through the bush. They perform good work in breaking down woody plant remains and are probably beneficial in improving the fertility of the soil, but on the other hand they often attack timber in buildings and have even been recorded on crops, especially during the dry season.

46. The termitaria are generally found under tree cover and start as elongated domes of black earth which are enlarged as the colony expands until they stand as much as two feet in height. By this time the termitarium generally has a capitulum or sometimes two, one beneath the other which serve as an umbrella. The galleries are mainly horizontal, $\frac{3}{8}$ inch in width with septa $\frac{1}{8}$ inch in thickness and contain eggs, workers and soldiers. The whole colony is never deep-seated and generally the queen is found at the base of the column or at most a few inches below ground level. In some cases there are as many as four queens. There is no elaborate or fortified queen cell and the queens are simply found in the larger sinuses.

47. *Cephalotermes rectangularis* Sjost.—A high bush species and one of the smallest termites. The termitarium is a flat dome consisting of a thin outer shell, an inner cortex of fine galleries in black earth, and a hard inner convoluted core. The queen is found in the centre of this core in a very hard cell. This species is a fungus cultivator and is not harmful.

48. *Ancistrotermes crucifer* Sjost.—Another minute species, is very destructive to lawns during the dry season. Its termitarium has not been observed.

49. *Microcerotermes fuscotibialis* Sjost.—An arboreal species. It builds its runways all over the trees on which its termitarium is located, but not much is known about its feeding habits.

50. *Macrotermes bellicosus* (Smeathman).—One of the most destructive termites in Sierra Leone. It is robust. Occurs in very large colonies and vigorously attacks lawns, crops, trees and timber in buildings. In the case of trees the *modus operandi* is to cover the bark with a mud shield and later attack it. The termitaria are marked by large irregular mounds of red or yellow earth with many pinnacles.

51. *Macrotermes natalensis* Haviland.—Like *bellicosus* in appearance and habits, but the soldiers are considerably smaller. Frequent in grassfields.

52. *Pseudacanthotermes militaris* (Hagen.).—In houses attacking timber and chala matting.

Apiculture

53. By far the most promising area for apicultural extension work is the Koinadugu District as is shown by the number of native hives already present there. These consist of plaited cylinders placed horizontally in the forks of trees. The bees thrive on the type of vegetation found there but the queen excluder principle is unknown, so that the brood is destroyed when the honey is extracted. A scheme was put up to Government for the introduction of a simple, inexpensive type of box hive with a queen excluder in this district.

Reference Collection

54. Three lots of named specimens returned by the Commonwealth Institute of Entomology included many new records for Sierra Leone which have been added to the reference collection.

(*d*) PRODUCE INSPECTION

90. Mr. K. S. Griffin was appointed as Inspector of Produce and arrived in January, since when he has been in charge of the Produce Inspection Branch. Thus for the first time since 1943, a substantive officer has been available, and with the recruitment of more examiners, this branch has begun to recover from the unsatisfactory state into which it unavoidably lapsed during the war period.

91. During 1947, twelve Grade III Produce Examiners and six temporary Produce Examiners, mostly ex-Servicemen, were recruited. The staff now consists of one Inspector, one Assistant Inspector, 25 permanent Examiners and six temporary Examiners. This increase in staff has meant that a good proportion of the year has had to be spent in training the new personnel. With the increased staff it was possible to open four new inspection stations, at Kambia, Segbwema, Pendembu and Zimmi, whilst at five main stations it was possible to provide two examiners instead of one.

92. Inspection work proceeded satisfactorily throughout the year except with piassava for a short period at the end of the year. A break occurred in piassava inspection during the rainy period June to November. During that period, in an attempt to overcome past complaints of damp shipments, no piassava dealing was allowed. Theoretically this was sound, but in actual practice it led to surreptitious dealing and storage during the rains. Some examiners, probably through lack of practice during the rains and from other causes, were not so efficient in examination when new buying started in November. This, in the difficult detailed examination necessary with piassava, allowed a certain amount of sub-standard material to be exported. However, remedial steps were taken and inspection soon showed improvement, although it is not yet entirely satisfactory.

93. The main produce inspected continued to be palm kernels, piassava and ginger but it is proposed to institute cocoa inspection in 1948. With this end in view there has been considerable instructional work amongst cocoa producers aiming at better fermentation and drying. At the same time traders have received advice in storage improvement. Cocoa quality, on the whole, is fair, but it now needs produce inspection legislation and the enforcement of storage regulations if further improvement is to be made.

94. In the case of all produce subject to inspection, up-country inspection has proved its value, and slowly but steadily is having an educative effect upon both producer and trader. There is, however, still a long way to go before perfection is reached. Close liaison is maintained between produce inspection staff and agricultural extension staff but their work is frequently handicapped by the traditional practices still too prevalent in producing areas and which give little incentive to the production of high quality material. Storage conditions in Sierra Leone, in general, leave much to be desired. These factors all tend against produce improvement and it is all the more creditable to the Produce Branch that overseas complaints for all inspected produce since the war ended have been so comparatively few.

95. The tonnages of the main export crops inspected by the branch in 1946 and 1947 were:—

	1946	1947
Palm kernels	46,773	61,240
Ginger	982	1,451
Piassava	4,118	2,958
	51,873	65,649

96. Other work of the branch included checking of weights and weighing machines and prosecuting where necessary. In addition prosecutions were instituted for offences against the Produce Inspection Rules, 108 convictions being obtained.

(*c*) MARKETING BRANCH

97. It had been felt for some time that, with modern technique developing in e processing and marketing of produce, a specialized section of the department as needed to deal with these aspects of crop production. Accordingly, in 1947, ajor S. M. Taylor, a fully qualified agricultural economist, arrived as Marketing fficer to organize and establish a Marketing Branch of the department. An frican, Mr. S. A. Pratt, B.A., B.Sc. (Econ.), was awarded a scholarship and proceeded the Oxford School of Rural Economy to receive further training with a view to ecoming Assistant Marketing Officer in the department.

98. The work of the Marketing Officer during the first year has necessarily cluded considerable basic research, collecting and collating a wide variety of formation and statistics from different sources, and bringing these facts and figures to concise, readily available up-to-date form. It was thought profitable for the Marketing Officer to pay an extended tour of nearly three months in Nigeria studying e processing industries and the produce inspection and marketing organisations tablished there. In addition to this basic work the Marketing Officer has played active part in processing trials, e.g. coffee, cinnamon, cashew nuts, fruit juices nd machine nutcrackers, and has co-operated in the oil-palm planting scheme nd produce inspection. He has been largely responsible for drafting the proposed ew Cocoa Inspection Rules and for working out details for the ordering and future tablishment of Pioneer oil mills. His advice and practical assistance has been ven to the Economic Survey Committee and to the Development of Industries Board.

99. The report of the Marketing Officer for 1947 is given below *in extenso* s an example of the preliminary work undertaken during the first year of starting Marketing Branch.

PART I—General

1. "I arrived in Sierra Leone on 31st January, 1947, to fill the new appointment of Marketing Officer in the Agricultural Department. Although the need for a Marketing Officer had been recognised by Government, his duties had not been defined. In April, 1947, after preliminary study of the problems involved, a provisional charter of my duties was submitted to Government.

2. A considerable part of 1947 was spent trekking to obtain a general picture of farming conditions, and at the same time to study production of the major export crops. In all, 176 nights were spent away from Njala. This includes a period of nearly three months' absence in Nigeria primarily to study developments in the oil-palm industry and secondary industries for which a separate report has been submitted.

3. A good deal of work has been general economic investigation, involving a study of the economic aspects of agricultural development projects. I have attended the meetings of the Economic Survey Committee, contributed to the collection of economic data, and after collation of this material will draft the committee's report early in 1948. I have also assisted the Development of Industries Board in an advisory capacity and reported to the Board on the possibilities of establishing various processing undertakings.

4. *Produce Inspection and Grading.*—This is an essential marketing function and full co-operation has been given to the Inspector of Produce. Instruction on methods of examining cocoa has been given and the drafting of Cocoa Inspection Rules is in hand. I have also suggested that full inspection of palm oil for export should be re-introduced.

5. *Expansion and Development of Markets.*—In conjunction with Headquarters Office, samples of coffee, cinnamon and cashews were prepared and sent to the Imperial Institute for examination. A very favourable report

on prepared Robusta coffee has been received; reports on cinnamon and cashews are awaited, but as the price of cinnamon has fallen considerably the prospects for this crop do not warrant any great extension of cultivation. Arrangements were made to send trial shipments of pineapples to the United Kingdom but unfortunately cool-room shipping space was not available. It is hoped to send shipments in March, 1948, when the next pineapple harvest is ready. It was proposed to send trial shipments of bananas to the United Kingdom as deck cargo in special packing but this was held up by the Ministry of Food, United Kingdom.

Both Chambers of Commerce support our proposal to send piassava samples to various European countries, Canada, Australia and South Africa in an endeavour to create new markets in these countries. This will be done early in 1948.

6. *Improvement of Internal Marketing.*—A preliminary study of this subject indicates that direct action is unnecessary and likely to upset the reasonably efficient existing organisation. Supply conditions and prices in 23 principal market centres are now collected and by dissemination of this information it is hoped to assist in equalising local surpluses and deficiences. General development of communications, construction of roads and extension of the telegraph system will contribute materially towards improving the internal trade in local foodstuffs.

7. *Introduction and Development of Processing Industries for Agricultural Products:*

(*a*) Primary attention has been given to mechanisation of the processes of palm oil and kernel extraction. This is a certain method of increasing production both by higher extraction efficiency (100 per cent more palm oil can be extracted by the Pioneer oil mill than by primitive hand methods) and through increased output of labour employed on this work. Two hand nutcrackers were tried out with satisfactory results, and a further twelve are on order, and two power-driven nutcrackers. I consider these nutcrackers have already been made obsolete by the development of the Pioneer oil mill, but they will serve a valuable purpose as the first step towards mechanisation. Government has agreed to the purchase of one Pioneer oil mill for installation at Masanki plantation, delivery of which is expected in early 1949. It is hoped that one other mill may be purchased to be erected in one of the dense oil-palm belts, and if it fits in with local conditions a large number will be required to effect the complete mechanisation of the industry.

(*b*) Machines for extracting citrus fruit juices for the manufacture of fruit drinks were received and tried out in December, 1947. Preliminary trials gave promising results. It is hoped that, by combining these machines with the equipment in the "jam factory" at Cline Town, a sound business to be operated under private ownership, manufacturing concentrated fruit drinks, canning grapefruit and later possibly jams, marmalade and chutney, will be established in 1948.

(*c*) Small hand coffee pulping and hulling machines were tested at Njala in December, 1947. These are efficient, low-priced machines which will considerably reduce the labour required to prepare coffee for the market and at the same time the introduction of the method of wet pulping and fermenting will improve quality.

(*d*) A trial consignment of cashew nuts was roasted by the hand method as employed in India. If the report from the Imperial Institute is favourable, together with reasonable market prospects, it will be for consideration whether machines for roasting and canning should be obtained.

(*e*) *Rice Milling.*—Several local applications for small rice mills have been made to the Development of Industries Board. Experience gained by operation of the department's mills at Rokupr and Kenema shows that this type of mill is efficient and suitable for use in the main rice-growing areas. Both mills are likely to be taken over by private operators in the near future. It can be expected that a number of these mills will be erected in the Protectorate in 1948.

8. *Crop Reports and Forecasts.*—Collation of crop reports provided by Agricultural Officers is now undertaken by the Marketing Branch. This service can only give information of a very general nature with present facilities. It is hoped that the staff of the Marketing Branch will be increased in due course to include crop reporters who would combine this work with crop surveys. By this means factual data would replace the present "eye observations". The supply position and prices of 48 kinds of foodstuffs and produce in 23 principal centres are obtained monthly from Agricultural and Produce Inspection staff. This information is compiled into an eight-page table which it is proposed to publish with the monthly crop reports in 1948.

9. *Economic Surveys.*—Work in connection with the Economic Survey Committee has been most valuable in providing a background of the country's organisation of production and general economy. In particular, the agricultural production map prepared for the committee will serve as a permanent feature for revision as more detailed information is collected through individual crop surveys, which will be made in due course. Attention has been given to the urgent need for an oil-palm survey and plans have been prepared for carrying out a "pilot" survey in 1948.

10. *Statistical Examination of Experiments.*—This branch is primarily interested in experiments both from the information they give on costs of production and from their application to survey work on crop yields and production. Suggested statistical designs for experiments on the economics of varying seed rates for rice nurseries, and for calculating yields by harvesting samples have been given to Agricultural Officers, Rokupr and Kenema. There is great scope for further work on statistical methods of obtaining crop acreages and yields by sampling technique which will be pursued in 1948.

11. *Production of Crops for Export.*—The world shortage of most raw materials and of all kinds of human and animal foodstuffs continued and was even accentuated in 1947. Sierra Leone farmers benefited by increased demand and higher prices for most kinds of produce.

(*a*) *Palm Kernels.*—The price increases at the end of February, 1947, from £12 12s. 6d. to £18 18s. 9d. per ton, together with other favourable conditions, resulted in considerably increased production compared with 1946, though still well below the average for the five-year period 1935 to 1939.

Year (Average)	*Tonnage*	*Return to Producer*	
		Average Price per ton	*Estimated Producer Receipt*
		£	£
1935-1939 ..	74,500	5	370,000
1946 ..	46,773	10	450,000
1947 ..	61,240	17	1,000,000

(*b*) *Palm Oil.*—Production also increased considerably during 1947, resulting in a surplus of 637 tons which was exported. Local price of palm oil varied considerably during the year, but producers received on the average about £30 per ton.

(*c*) *Piassava.*—Prices broke sharply in March, 1947, and for the remainder of the year producers received little more than half of what they had been getting during the latter part of 1946 and the first two months of 1947. This fall in producer price from about 30s. and 20s. per 56 lb. bundle to 18s. and 10s. 6d. for Prime Sherbro and Sulima grades together with the institution of the "close season" from 15th September to 31st October has resulted in both reduced production and a falling off in quality of preparation. In December, 1947, there were some signs of improvement in overseas demand and if this results in better prices the 1947 export of 2,958 may be equalled or bettered in 1948.

(*d*) *Ginger.*—A satisfactory price of 4d. per lb. to the producer in 1947 resulted in almost 50 per cent increase in exports over 1946, the export of 1,451 tons being almost up to the pre-war average annual figure, though nearly 1,000 tons below exports in 1937 to 1939.

(*e*) *Kola.*—Exports of kola in 1947 at 2,300 tons represented a 1,000 tons increase over 1946, and the highest since the 1920 30 period. Although prices varied considerably during the year producers obtained 4d. to 6d. per lb. and occasionally better. The extent to which the 1947 increase can be maintained is problematical, as it resulted from partial crop failures in competing producing countries and increased purchasing power in consuming areas. But any reduction in import duties on kola in the Gambia and French Guinea would undoubtedly result in greater exports of Sierra Leone kola.

(*f*) *Cocoa.*—The 1946–47 crop exported in 1947 amounted to 439 tons, a decrease of 140 tons compared with 1946. During 1947 propaganda and the prospect of an increased price stimulated producers' interest in their cocoa plantations. The increase in price from 3½d. to 6d. per lb. was announced in October, 1947. The 1947–48 crop, harvesting and preparation of which was practically completed by the end of 1947, was the largest ever, and will be at least 800 tons.

(*g*) *Coffee.*—Exports of coffee, practically all Robusta, amounted to 276 tons in 1947 from the harvest of the 1946–47 crop. This was double the 1946 export and the largest ever produced. The principal cause of this increase was the improved price of 5½d. per lb. compared with about 3½d. for the 1946 crop.

(*h*) *Benniseed.* –Production in 1947 increased substantially and the crop for which producers receive 3d. per lb. is estimated at 200 tons which will be available for export in 1948.

(*i*) *Miscellaneous.*—The present good external market for such produce as copra, beeswax, chillies and Calabar beans can be expected to stimulate production for export on a limited scale.

PART II

12. A detailed account of tests carried out personally by the Marketing Officer on the processing/preparation of various products is given below:—

(i) *Cinnamon:*

Samples of cinnamon were prepared at Njala and Newton in June, 1947, from agricultural station cinnamon plantations. These samples consisted of "quills" and "chips" and were despatched to the Imperial Institute for a trade report and chemical analysis. Samples of the quills were also sent to the principal Sierra Leone export firms. The report from the Imperial Institute is still awaited, but firms showed considerable interest and offered 1s. 3d. to 1s. 9d. per lb. to producers. The price of Ceylon cinnamon has fallen steadily since that date, and it is doubtful whether our cinnamon would sell at 1s. per lb. now.

The Ceylon method of preparation was followed, though a considerable amount of practice will be required before workers acquire sufficient skill. Two years old coppice shoots were used of five to six feet length and half inch to one-inch diameter. The outer woody bark was first scraped off clean, taking care not to break the inner layer of bark. The inner layer was then peeled off in one piece, each piece being six inches to eight inches long, i.e. an inter-nodal section. The sections of bark were rolled tightly to form a quill about two feet six inches long which was then laid out in the sun to dry. Chips were made from broken pieces of quills, or by chipping off the inner bark in cases where it did not peel easily.

The labour costs at Njala in preparing the cinnamon samples were high, due to inexpertness and lack of application. In 73 man-days only 34 lbs. of quills and 56 lbs. chips were produced. Valuing quills at 1s. 3d. per lb. and chips at 6d. per lb., the value of cinnamon produced was only £3 10s. 3d. at a labour cost of £5 9s. 6d.

Cinnamon appears to grow strongly on poor soils, but it is doubtful whether its extended cultivation can be recommended in view of the variable export market and the skill and application required for its preparation.

(ii) *Cashews:*

Samples of roasted cashew kernels were prepared at Njala from cashews grown at Newton. The Indian native method of preparation was followed, which was quickly learnt, after a little practice, by an instructor. Details of this process are given below. A perforated pan which gave very satisfactory service was made by the station blacksmith from one end of an old cement drum. The end of the drum was cut off leaving sides about three inches high, handles were rivetted on at either side and holes punched through the bottom.

A single layer of nuts was placed in the pan and "fried" over a native type fire on three stones. During frying it was necessary to continuously agitate the nuts to obtain even roasting without excessive charring. After frying for two or three minutes shell oil was liberated which gave off a very acrid smoke and some flame. Frying was completed after about ten minutes. Nuts were then tipped out into sand to absorb the remaining shell oil, and when cool enough were carefully cracked with a light hammer to extract the kernels. Finally the kernels were baked for about an hour in a domestic oven at low temperature to facilitate removal of the membraneous skin which can then be taken off easily with the fingers. At this stage kernels had a glossy ivory coloured surface, any broken or overcooked brown kernels being picked out.

A 3 lb. sample of roasted kernels prepared in this manner was packed in biscuit tins and sent to the Imperial Institute in October, 1947, for report which has not yet been received. At the same time two samples of cashew nuts one of the "red" and the other of "white" variety were sent to the Institute for examination and report on suitability for extraction of shell oil.

(iii) *Palm Nutcracking Machines:*

A hand-operated nutcracking machine was tested out at Jayahun village in Dasse Chiefdom on 9th and 10th April, 1947.

Specification of Machine:

Miller Patent Nutcracking Machine, Model A.
Ball bearing with two handles.
Capacity 4 to 5 cwt. nuts per hour.
Efficiency—95 per cent cracked nuts.
Weight—262 lbs.
Price—U.A.C. delivered Njala, £45.

—	Weight of Nuts lbs.	TIMINGS: Machine Running Mins.	TIMINGS: Stop Mins.	TIMINGS: Total Mins.	UNBROKEN NUTS: Weight lbs.	UNBROKEN NUTS: Percentage	KERNEL OUT TURN: Weight lbs.	KERNEL OUT TURN: Percentage	CAPACITY PER HOUR TOTAL TIME: Nuts lbs.	CAPACITY PER HOUR TOTAL TIME: Kernels lbs.	Remarks
1st Run	359	25	13	38	28.5	7.94	51.5	4.35	566	81	Old nuts collected from under trees
2nd Run	467	23	12	35	27.5	5.9	97.5	20.9	737	167	Fresh nuts
3rd Run	476	32	33	65	—	—	—	—	440	—	Old nuts
4th Run	624	43	22	65	—	—	—	—	596	—	Fresh nuts
5th Run	253	11	5	16	11	4.3	60	23.8	948	225	Fresh nuts
6th Run	190	10	—	10	—	—	—	—	1,140	—	Fresh nuts
7th Run	712	48	32	80	—	—	—	—	534	—	Fresh nuts

Note.—Final picking out of kernels in runs 3, 4, 6 and 7 were not completed on the days of trials.

Conclusions.—This type of machine is efficient, robustly constructed and suitable for use throughout the country in areas of dense oil-palms. The cost of using this machine, excluding labour, is about 3d. per bushel of kernels produced.

A method of separating kernels from shell was introduced by the Department many years ago and has been taken up in a few parts of the country. As nutcrackers are distributed in future this method will be demonstrated to all users of the machines. The method is simple and requires the minimum of equipment: clay, reasonably free from sand, which is available locally in most areas, is thoroughly stirred in a drum or other suitable container of water. The clay solution should have a specific gravity of about 1.2, but the test of whether the density is right is to see that kernels float and shell sinks. A native basket containing the mixture of kernels and shell is then lowered into the " clay bath ", though not submerged, and moved up and down, at the same time shaken. After about a minute all the kernels float to the top and are skimmed off by hand, the shell being discarded. The kernels are washed in clean water and finally spread out on mats for drying. It is hoped that delivery will be given in 1948 of 12 hand and two power-driven nutcrackers, now on order, and also a number of nutcrackers ordered privately. At the end of 1948 we should be able to review the first stage in mechanisation of the oil-palm industry.

(iv) *Coffee Pulping and Hulling Machines.*—Small hand pulpers and hullers were tested at Njala in December, 1947.

Pulpers.—Machines used were an old and a new model MTOTO pulper, and a small simplified MTOTO pulper. It was necessary to mount the machines on sturdily constructed wooden stands 2′ 6″ to 3′ high.

During the tests it was found that the old model MTOTO did not remove the pulp as efficiently as the new model although every effort was made to adjust it. The simplified MTOTO, although it removed the pulp reasonably efficiently, is too reduced in construction, in particular it has a very small badly designed handle; I do not recommend this machine.

The new model MTOTO worked very satisfactorily and dealt with practically the whole of Njala coffee crop.

RECORDS OF TESTS USING NEW MODEL MTOTO PULPER

Weight of fresh Berries	*Time*	*Berries per hour*	
lb	*Mins.*	lb	
125	45	166	
115	35	198	
132	58	136	Average—156 lbs. per
110	55	190	hour.
192	85	135	

Pulp was not fully removed from a small number of cherries and this had to be picked off by hand. To ensure efficient pulping the following conditions are essential:—

(*a*) Cherries must be freshly picked and fully ripe, though if over-ripe and the pulp has dried, they will not pulp. If pulping cannot be done on the same day as picking the cherries should be placed in a container of clean water until pulped the next day.

(*b*) A supply of water is essential and a continuous stream of water must be fed to the pulper with the coffee cherries.

This MTOTO pulper is efficient and suitable for introducing in all main coffee-growing areas. If worked to capacity one machine could deal with the crop from 20 to 30 acres, and would therefore be enough for most coffee-growing villages. Cost of the machine was £6 to the department or, say £7 to private buyers, and a stand would cost another 10*s*.

Hullers.—Machines used were an old model Africa No. 6, a new Africa No. 10, and the Bukoba model. The old model although producing clean coffee from dry cherry gave such a poor output that it was discarded.

(*a*) *Hulling Dry Cherry.*—A test was carried out to compare the efficiency of the Africa No. 10 (11354), the Bukoba and pounding in mortars.

	Weight of dry Cherries	*Weight of clean Berries*	*Time*	*Number of Men*
	lbs.	lbs.	*Mins.*	
Africa No. 10 ..	50	27	70	3
Bukoba ..	50	27.13 ozs.	75	2
Hand-pounding ..	50	26.6	135	2

Both machines appear to have about the same capacity and approximately double that of the mortar-pounding method; but account must be taken of the extra man required to work the Africa No. 10 as this is a 2-handled machine.

The Bukoba huller is a very suitable machine for hulling Robusta coffee dried in cherry; it is efficient, requires no adjustment, could be worked by one man with a child feeding in the cherries. The cost is reasonable, £4 approximately to private purchasers, plus a wooden stand costing 10s.

The Africa No. 10 was disappointing, possibly due to incorrect adjustment; manufacturers claim an output of 50 lbs. clean berries per hour but only about half this was obtained in the test. It was very hard work for 2 men turning the handles, and it is considered that this machine, which is very strongly constructed, is more suitable for a power drive. It is rather expensive, costing about £18, and requires a strong wooden stand.

(*b*) *Hulling Parchment Coffee.*—The Bukoba does not appear to hull parchment coffee clean although the manufacturers claim it to be suitable for this work.

The Africa No. 10 is quite satisfactory for this work though the output of clean coffee per hour obtained in the tests was lower than the manufacturers' figure, being 60 lbs against 80 lbs. This was probably due to the low efficiency of the labourers, though the machine is rather heavy to work and would be better driven by a small engine.

It is most essential that cherry or parchment coffee is thoroughly dry before hulling. If not completely dry, it cannot be clean-hulled and a high percentage of berries will be broken.

(*c*) *Winnowing.*—A hand winnowing machine to clean after hulling would be a great advantage and very considerably reduce labour requirements of coffee preparation.

(v) *Manufacture of Fruit Squashes.*—The department had carried out experiments in fruit preservation by canning grapefruit, in 1938 and 1940, with promising results. A considerable quantity of jam and marmalade was also manufactured during the war for the army. The commercial possibilities of fruit squash manufacture were also appreciated and machines for extraction and filtering fruit juices (Scooping and Pulping machines) were ordered and delivery obtained in 1947. A preliminary trial in preparing fruit squashes was conducted at Njala in December, 1947, with promising results, and further trials were made at Freetown in January, 1948. Details of these trials are given below:

Method of Preparation.

(*a*) All parts of the Scooper and Pulper (stainless steel) which come in contact with fruit, and all accessory equipment were sterilised by boiling in water.

(*b*) Whole fruits were thoroughly washed externally in cold water to which potassium permanganate was added.

(*c*) Fruits were cut into halves transversely on a table convenient to the Scooping machine.

(*d*) Cut halves of fruit were pressed against the revolving cones of scooper, the expressed juice containing cell tissue, pips and septa being collected in stainless steel buckets.

(*e*) The mixture of juice, cell tissue, etc. was passed through the pulping machine which removed the larger pieces of cell tissue, septa, pips, etc. leaving the juice with small fragments of cell tissue characteristic of squashes.

(*f*) Sugar was added to the fruit juice and the syrup was heated to boiling temperature, but only boiled for one to two minutes.

(*g*) Preservative, (potassium metabisulphide: K.M.S.) 1 teaspoonful of a solution of 1 oz. K.M.S. in 20 ozs. of water, was added to one pint of syrup which was then bottled and corked. At Njala bottles were closed with corks which were sealed with beeswax and tallow or with paraffin wax. A crown corking machine was used at Freetown.

(*h*) *Capacity of Plant.*

It was noticeable that labourers rapidly increased production with increased practice. The preliminary trials at Njala and the further trials at Freetown indicate that the following are conservative figures:—

(*a*) Scooping and pulping—5 gallons fruit juice per hour.

(*b*) Boiling facilities can cope with a much greater production as the two boilers each have a capacity of 20 gallons, and the boiling process takes less than half-an-hour.

(*c*) Bottling must be delayed about half-an-hour after boiling, to allow for some cooling. It was found that about one bottle per minute can be filled with a jug. Crown-corking is a rapid process.

With the present equipment the most efficient organisation would be to employ four men who would carry out all the manufacturing operations in sequence:—

0700 hours –1200 hours—extract 25 gallons juice.

1200 hours–1300 hours—boiling.

1300 hours–1400 hours—bottling and crown-corking.

1400 hours–1500 hours—fixing labels and cleaning up.

Production would be approximately 200 bottles per day.

The following average figures of output of fruit juice for different kinds of fruit were obtained.

2½ dozen grapefruit gave 1 gallon juice.

5 dozen oranges gave 1 gallon juice.

4 dozen lemons gave 1 gallon juice.

Oranges used were below average size and normally it can be expected that 4–4½ dozen would give a gallon of juice.

Costs of Production.

Organised as above, estimated costs for grapefruit squash would be as under:—

	£	s.	d.
62½ dozen grape fruit @ 1s. per dozen	3	2	6
100 lbs. sugar @ 6½d. per lb.	2	14	2
200 bottles and crown corks @ 2d. each	1	18	4
1 Supervisor @ 5s.	0	5	0
4 labourers @ 2s. 3d. each	0	9	0
Overheads and sundries	0	10	0
Cost per bottle—10¾d.	£8	19	0

Lemon juice could be mixed with the grapefruit, which would then require a little more sugar and, with higher price of lemons, would increase production costs to not more than 1s. per bottle.

Quality of Product.

The grapefruit squash made at Njala in the preliminary trials appears to have better keeping qualities and a rather better taste than that made at Freetown. The reason for this may be that the fruit used at Freetown was a little overripe and the cooking process in the steam-jacketed boilers may have been too rapid. It will take some experience, manufacturing on a commercial scale, to determine the flavour most popular with the public. As a result of these trials and earlier tests made by the department the following recommendations can be made:—

(*a*) It is considered that the "jam factory" provides the essentials for establishing a profitable processing industry which can supply local requirements, thereby reducing expensive imports. At the same time it will absorb some surplus citrus fruits.

(*b*) The jam factory should be handed over as soon as possible to a suitable African business concern, and the following terms are suggested: All equipment to be sold outright at a valuation; the building to be leased for a period of ten years; steam to be provided at a reasonable charge from the rice mill boiler; a fence to be erected around the factory with separate entrance.

(*c*) To make the factory a complete unit it is essential that it has its own source of steam. It is suggested that electric steam boiler be installed, and details have been asked for from a firm in the United Kingdom. A sterilising cabinet for bottles, etc. is also needed. Sundry other equipment and a crown-corking machine would be supplied by the private firm.

(*d*) The business should start by making fruit drinks and later, as experience is gained, would can fruit, next tomato puree, and if possible bottle or can jams, marmalade and chutney.

(*e*) The Development of Industries Board should give financial assistance if the applicant for the factory has insufficient capital.

(*f*) Agricultural Education

100. The training of Agricultural Instructors continued at the Njala Training College, now in its ninth year. For the first and last quarters of the year Mr. T. P. Wheldon, Agricultural Officer, was in charge. During the period he was on leave Mr. J. A. Austin, Agricultural Officer, took charge. The report of the course for 1947 is as follows:

101. A complete revision of the agricultural syllabus was carried out early in the year. The rapid increase in academic standard on entry necessitated this, and while still planned as a four-year course, it will be easily modified into the three-year course which is envisaged for the near future. Two groups are at present in training The senior group, which was recruited in July, 1944, completed their course of instruction at the College, the last six months of their scholarship period being given to field training, when they will be posted to the various Agricultural stations in the Protectorate where they will gain experience not only of the station work, but also of extension work under the field Agricultural Officers. This group on the whole, is a very satisfactory group who have worked enthusiastically throughout their time at the College. They completed the third year of their course in July, and the latter half of the year was given to the co-ordination of all subjects studied during the three years into one broader conception of agriculture. Subjects studied during the year included Animal Husbandry (Nutrition and Management), Zoology (with Entomology), General Agriculture, Produce Preparation and Legislation, Plant Diseases and Plant Protection, Surveying (which was devoted to levelling and the mechanical means for erosion control), Arithmetic and English. The final examinations were set in the following subjects: Animal Husbandry, Zoology (including Plant Protection), Surveying (Practical and Theoretical), Crop Husbandry, Produce Preparation and Legislation, Ecology, Nursery Practice, Agriculture (general), Agriculture (oral), Arithmetic and English.

102. The junior group, recruited in January, 1946, completed the second year of their course. One student resigned his scholarship. This group is generally of a higher educational standard than the senior group, and it is pleasing to find with this higher academic standard a competent tailor, a trade certificated mason and carpenter. Subjects studied were Crop Husbandry (with particular reference to rice cultivated in Sierra Leone), Nursery Practice, Ecology, Botany, Zoology, Surveying, Arithmetic and English. Examinations were set in these subjects with the addition of General Agriculture.

103. Both groups continued to work daily for three hours on the College Farm. The system of appointing a Student Bailiff and Student Overseers for each farm section each month continued, and it has been found to be an excellent means of inducing a sense of responsibility and of learning labour management.

104. The system of regeneration by a five-year grass ley was continued on the College Farm, but there was a partial failure of graminaceous crops planted. The Agricultural Officer, Training College, and the Agricultural Chemist are to investigate this in 1948, as this is not the first time a partial failure of graminaceous crops after an elephant grass (*Pennisetum purpureum*) ley has occurred. Other crops were satisfactory apart from benniseed (*Sesamum indicum*) which produced excellent inflorescences which, however, were badly attacked by a gall midge which has not yet been identified. The permanent plantation crops were satisfactory.

105. The nursery and vegetable garden was terraced this year, and a large quantity of "European" and local vegetables were grown. The livestock section was increased by a pair of rabbits, which reproduced sufficiently to require a battery of hutches. This provides valuable experience in the handling and care of small animals. A small piggery has been started, consisting of a fattening and farrowing pen, and it is hoped that this will be completed early in 1948.

106. In addition to working on the College Farm, each student cultivated his own garden for which the greater part of the seed and planting material was supplied by the College.

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Director of Agriculture.

DEPARTMENT OF AGRICULTURE,
NJALA, *via* MANO,
24th June, 1948.